Periodicals
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McGraw-Hill Publishing Company, Inc.

April 1934

Construction Methods

Beginning This Month:

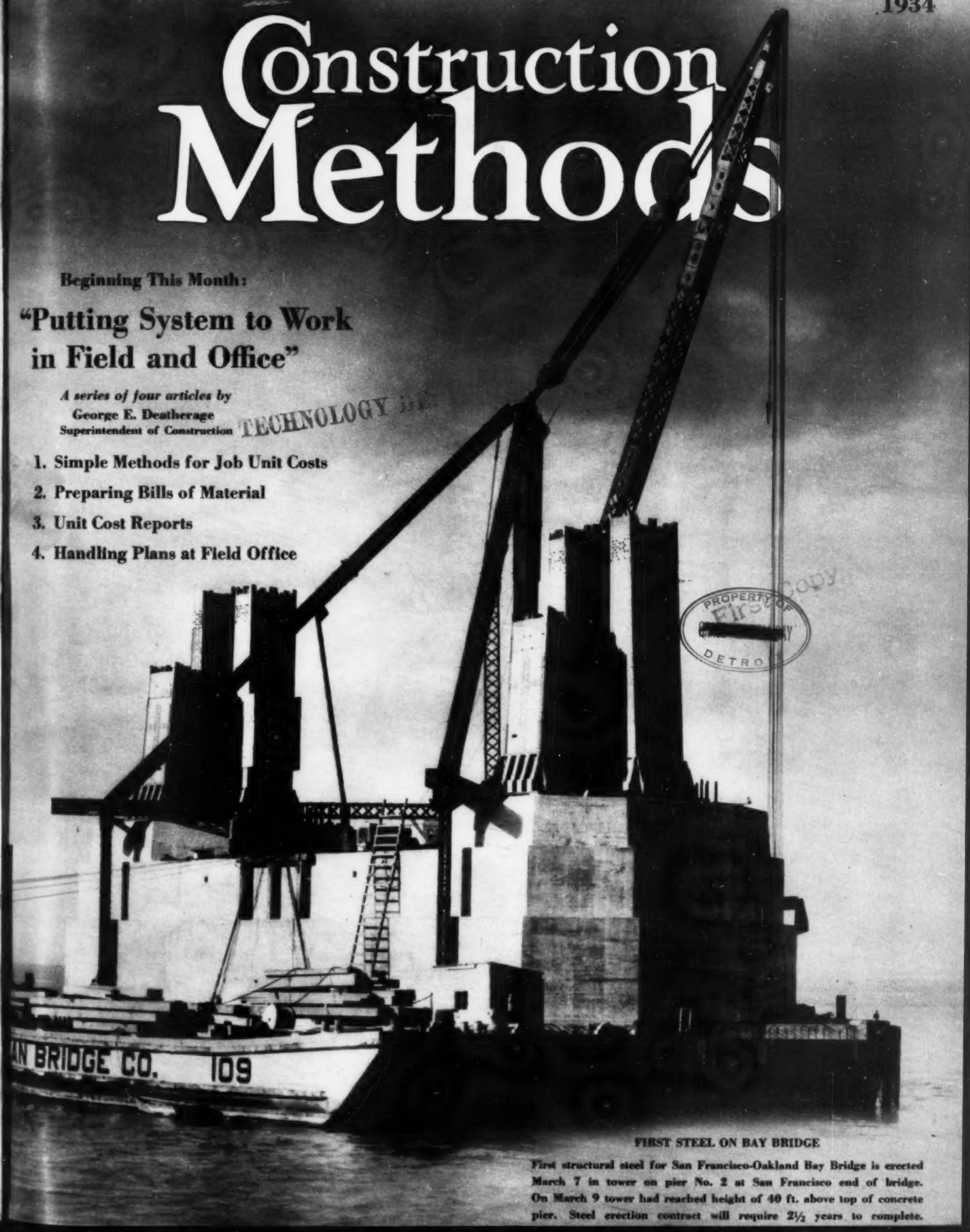
"Putting System to Work in Field and Office"

A series of four articles by
George E. Deatherage
Superintendent of Construction

TECHNOLOGY

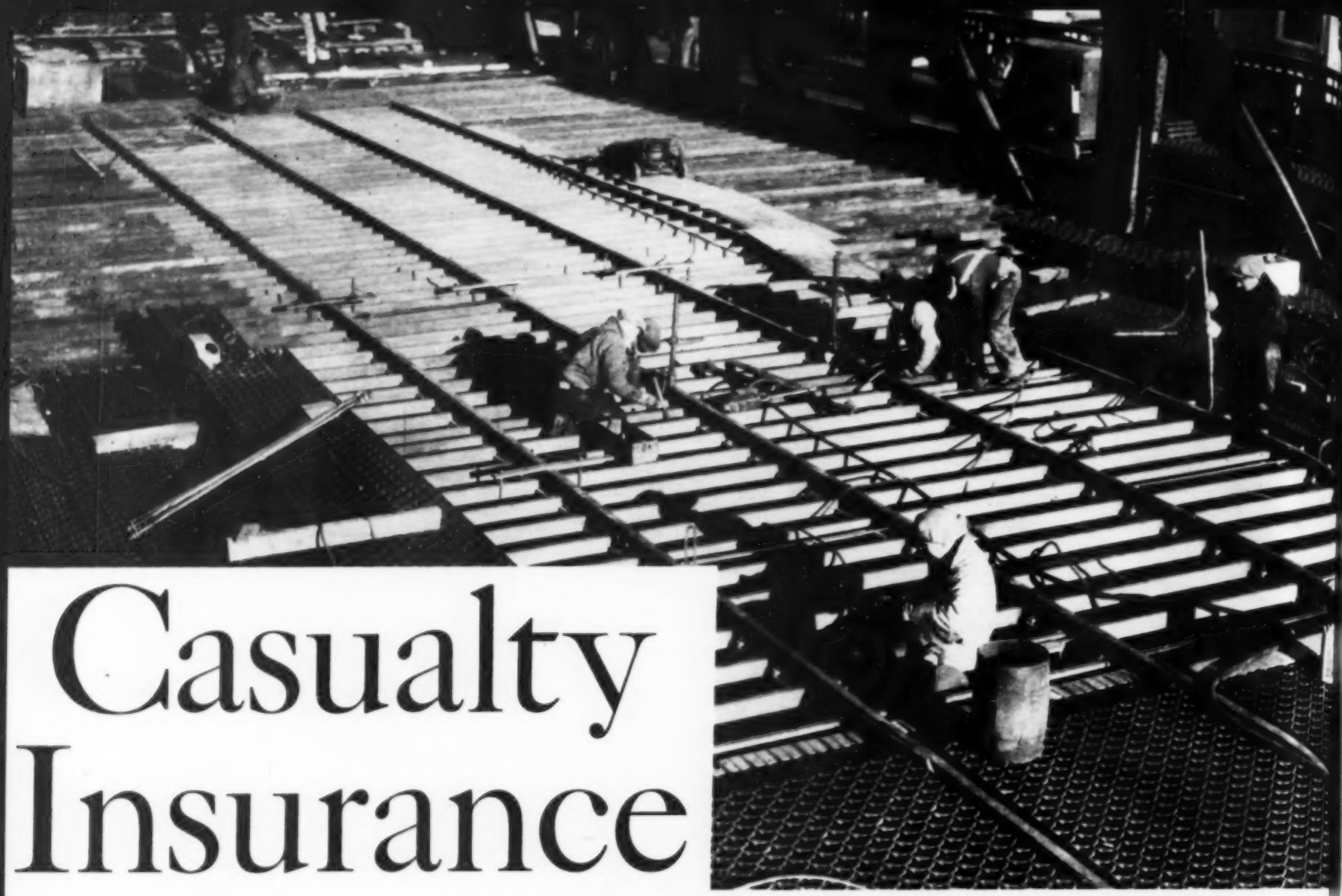
1. **Simple Methods for Job Unit Costs**
2. **Preparing Bills of Material**
3. **Unit Cost Reports**
4. **Handling Plans at Field Office**

First Copy
PROPERTY OF
DETRO



FIRST STEEL ON BAY BRIDGE

First structural steel for San Francisco-Oakland Bay Bridge is erected March 7 in tower on pier No. 2 at San Francisco end of bridge. On March 9 tower had reached height of 40 ft. above top of concrete pier. Steel erection contract will require 2½ years to complete.



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Construction Methods

McGraw-Hill Publishing Company, Inc.,
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Vice-President

ROBERT K. TOMLIN, Editor
Editorial Staff: Vincent B. Smith, N. A. Bowers (San Francisco)
Leonard H. Church (Cleveland), Nelle Fitzgerald

Construction Code Authorities Organized

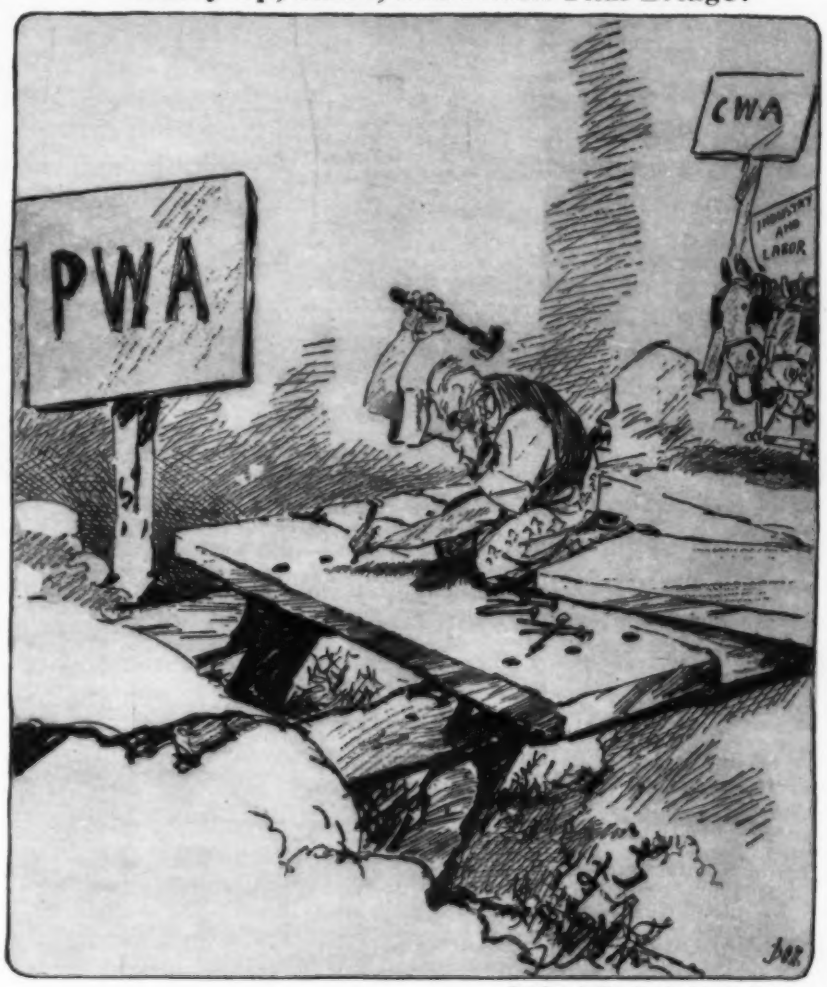
● From the job of code-making, which has been completed in large part by the approval of a basic general code (Chapter 1), a divisional code for general contractors (Chapter 2) and several of the subcontracting codes, the construction industry has turned its attention to the important task of code administration. The personnel of the Code Authorities for the industry at large (John F. Voorhees, chairman) and for the General Contractors' Division (A. E. Horst, chairman) has been selected and these bodies are at work organizing and developing plans and procedure for regional and local self-regulation under government supervision, as required by the National Industrial Recovery Act. One of the first actions of the General Contractors' Divisional Code Authority, last month, was to require the registration of all construction work and services exceeding $2,000 in value. Still pending under the approved divisional code for general contractors are the three sub-divisional chapters or supplementary codes covering the separate functional activities of (1) building contractors, (2) heavy construction and railroad contractors, and (3) highway contractors. Early submission and approval of these codes and appointment of their respective Administrative Committees will complete the machinery for insuring compliance with rules of fair competitive practice.

Economic Effect of Code

● In transmitting the basic Construction Industry Code for presidential approval, National Recovery Administrator Hugh S. Johnson referred to its "very great potential economic benefits." The code gives to the construction industry for the first time, he said, the power of coordinated action, which may be used to check the violent fluctuations in volume of construction, ranging from 100 per cent above to 50 per cent below normal requirements; to work toward stabilization based upon demand; to unify the industry locally, regionally and nationally for self-government; and to provide unity of action in meeting national emergencies.

The provisions of the code designed to prevent practices known as "bid shopping" and "bid peddling" will be productive of fair competition in contracting for construction work. These provisions, in conjunction with the provisions as to area agreements governing wages, hours of work and other labor conditions, should greatly facilitate strict adherence by all members of the industry to such code provisions as those intended to prevent "bid peddling" and thus tend to create equally the same conditions for labor and members of the industry.

"Hurry Up, Sam'l, and Finish That Bridge!"



Donahey, in The Cleveland Plain Dealer

Bidding and Trade Practices

● Supplementing the summary of the main provisions of the General Contractors' Divisional Code, in last month's issue, the following additional regulations are now in force with regard to bidding and trade practices: Whenever contracts are to be let by competitive bidding the terms must be such as to insure fair competition on both public and private work. Bona fide mistakes discovered after the opening of bids shall be grounds for withdrawal only. Where supplemental bids are requested because of substantial changes in the plans or specifications such bids shall reflect only the true value of the changes.

A general contractor must own or have available sufficient and proper equipment to execute the work bid upon or furnish evidence of his ability to acquire such equipment. He is forbidden to enter into any agreement or understanding prior to the award of a contract, where such award is made as a result of competitive bidding, by which he agrees to accept a lesser amount for his services than the amount stated in the bid. In competitive bidding a general contractor shall not offer or agree to assume responsibility for deficiencies in or omissions from the plans or specifications which he has not prepared or caused to be prepared by others, and upon which the contract is based, for the purpose or with the effect of securing an unfair competitive advantage. He must comply with the provisions of the safety manual of the Associated General Contractors of America and shall not employ prison labor. Wages must be paid in lawful United States currency or by a check negotiable at par on demand.

Certificates of Code Compliance

● Actual compliance with NRA codes on Government contracts and contracts involving the use of Federal funds is required by executive order of the President issued March 14. To be eligible, bidders must file a certificate of compliance, although signature of the code applicable to their industry is not a prerequisite. The effect of the President's action is to put a stop to the award of contracts on low bids that, under a ruling by the Comptroller General, were accepted regardless of whether or not the bidder had complied with the appropriate code or reemployment agreement. The President's order also applies to all contracts and purchase orders by states, municipalities, local subdivisions, persons and corporations in connection with projects financed wholly or in part by a Federal agency, such as the Public Works Administration.

No conflict is seen by PWA between the President's order and the practice with which bidders now are required by PWA to conform. Bidders furnishing equipment, materials and supplies on PWA projects now are required to comply with the appropriate code or reemployment agreement. Labor employed directly on the project is subject to the 30-hour week and minimum hourly wage rates of $1, $1.10 and $1.20 for skilled labor and 40c, 45c and 50c for unskilled labor, under the agreement last August between PWA and the American Federation of Labor.

Return to Normal Volume

● General Johnson concluded his comment on the code with the following reference to present and probable future conditions in the construction industry: "Return to normal volume in the industry can result only through investment of private capital in construction. The increased cost of construction, due to an immediate increase in wage rates, will not be productive of private construction work at the present time. Such work is optional and depends to a large extent on the relationship of current construction cost to anticipated net income or future increment in value. In these circumstances, further limitation on hours will have little effect on increasing employment, as construction volume has sunk to such low levels that it is impossible to spread the small amount of work among a greater number of people without reducing all wage payments below a minimum living wage."

No Job for an Eye-Dropper

NOW that CWA is going out of business the administration must take a new and more realistic view of PWA and its objectives. Until recently those in authority have expected that by the time CWA funds were exhausted a rising tide of employment, stimulated by PWA projects, would have absorbed a large share of the unemployed.

All this might have been realized if, from the beginning, PWA had been alive to its responsibility. But it was not. Misconception, undue caution, bureaucracy and downright obstruction were permitted to hamper its progress. Now it is clear that employment through PWA activity has not yet attained the volume that might reasonably have been expected with the opening of spring. Early allotments to vast federal projects bulk impressively on PWA publicity releases, but they create little employment in the capital industries during this year of grace. Centralized and meticulous censorship of non-federal projects exalts the self-righteousness of an administrator, but it plays havoc with the recovery plans of the President. Diversion of PWA funds to CWA relief may, for the moment, tide over an unemployment crisis, unduly aggravated by PWA delay, but unless that delay be ended such a diversion merely perpetuates the conditions that have made it necessary.

Getting a start with the local projects that are so essential to the success of PWA has consumed the better part of a year. During that time many agencies, both public and private, have labored to enlist local communities in the PWA effort and in some cases to foster the enactment of enabling legislation. Today these efforts are bearing fruit and hundreds of applications await consideration. But now we are told that PWA funds have all been allotted.

It is true that most of the actual work represented by those allotments has not yet been started and that much if it will get under way with the current season. This beginning, however, will fall short of the need unless the present Congress provide ample appropriations with which to carry on. *No greater responsibility now rests upon the Congress and the administration.*

This use of the word "ample" rather than "adequate" is deliberate. The ultimate purpose of public works investment is to revive private investment, through which alone general prosperity can be restored. This will come only with confidence that the current revival of trade will continue. So long as private business is skeptical on this score it will withhold its essential participation and thwart the present tendency toward recovery. But once we assure the continuity of a public works program, once business men feel certain that this impetus will persist until private industry has "caught on", we shall have guaranteed success.

Under such a guarantee private business will step out boldly, and more than likely we shall find it unnecessary to carry through the full program of public expenditure.

But half-hearted and faltering conduct of public investment, however vast the appropriation, will not nourish business confidence. We cannot prime a pump with an eye-dropper. *So we need not only an ample appropriation but also a vastly accelerated rate of expenditure.* Under present conditions, rate is even more important than is volume.

So let us have from the Congress an appropriation ample to guarantee a continuance of the program. In order to provide the maximum of employment let it be directed toward those types of work that will insure most rapid translation of allocations into the most widespread employment. To insure that allocation may be more than a gesture, let PWA decentralize its administration. To guide expenditures most directly into the dried-up channels of industry, let them be applied through normal contracting procedure, and let modern methods and equipment be required on every project. In order that PWA may at last have a chance to achieve its objective, let no emergency program of relief again invade its field or otherwise interfere with its essential effort for industrial recovery.

These are the essential specifications for success. If PWA is to do its part in the President's recovery program, they must be met in full; and this calls for energetic cooperation between the present Congress and those in charge of the Public Works Administration.

Willard Chevalier

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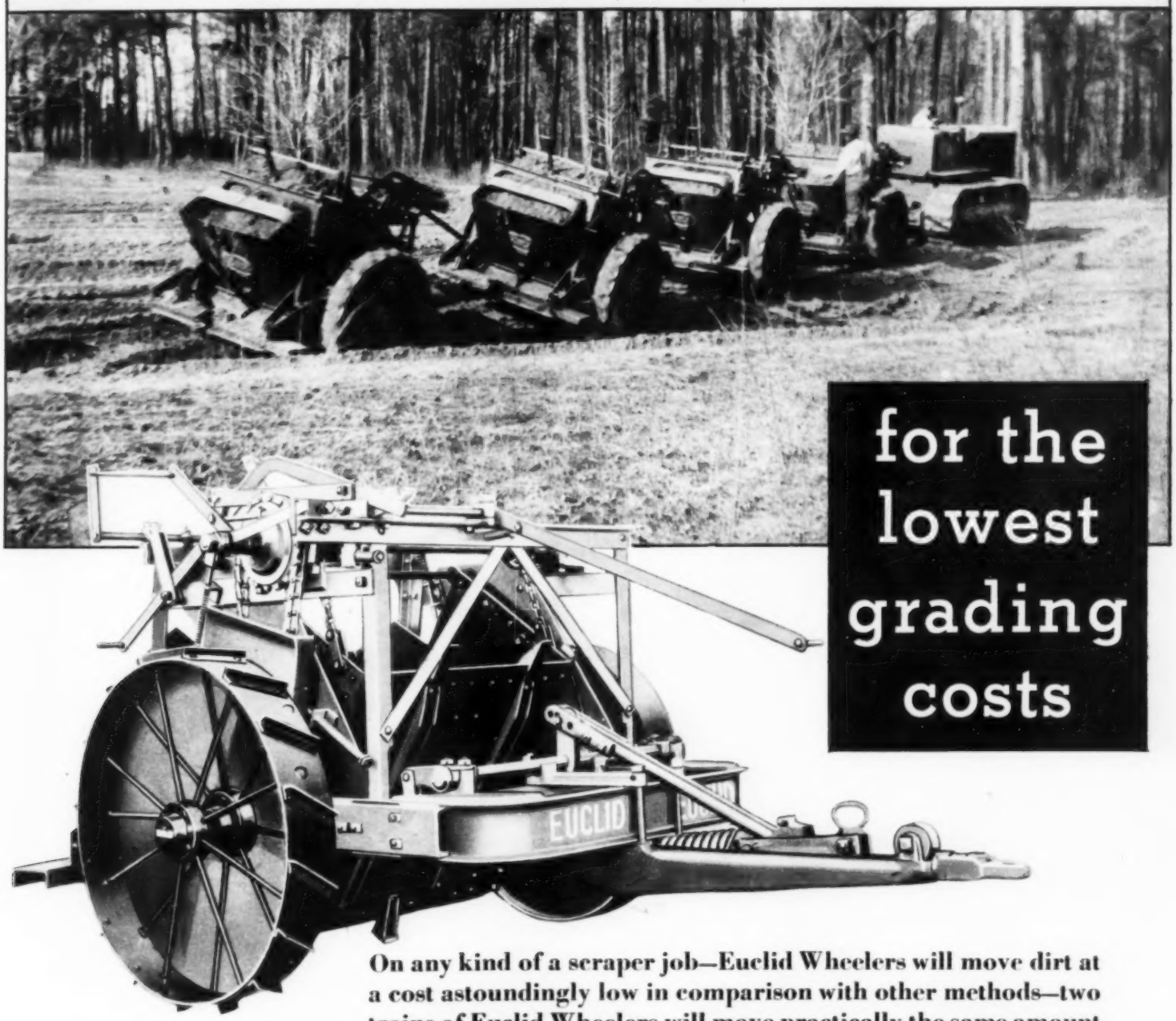

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On any kind of a scraper job—Euclid Wheelers will move dirt at a cost astoundingly low in comparison with other methods—two trains of Euclid Wheelers will move practically the same amount of dirt in a day as a 1¼ yd. shovel with the necessary hauling units; and the investment is approximately only *one-half* as great. Every contractor should have at least two trains of Euclid Wheelers to round out his grading equipment. In nearly every state there is scarcely a job let that does not include some portion which can be *economically completed* with Euclid Wheelers.

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It is with pleasure, I forward you a photograph of our semi dump trailer, after it has operated 85,975 miles.

This piece of equipment weighs when loaded 41,000 pounds, and the pay load is 23,500 pounds. The haul it is working on averages 58 mile per round trip, and makes five trips per day.

At the time this equipment was purchased the truck engineers estimated a life of 30,000 miles for the tires, which are 975-20. We feel very fortunate that we specified Firestone High Speed Tires on the original equipment, as we only replaced the four drive wheel tires, when they became smooth, after going 58,000 miles. The remaining six tires are still on the truck and we expect to get 100,000 miles on these tires.

We are more than pleased with the performance of Firestone Tires, and we will surely replace with same.

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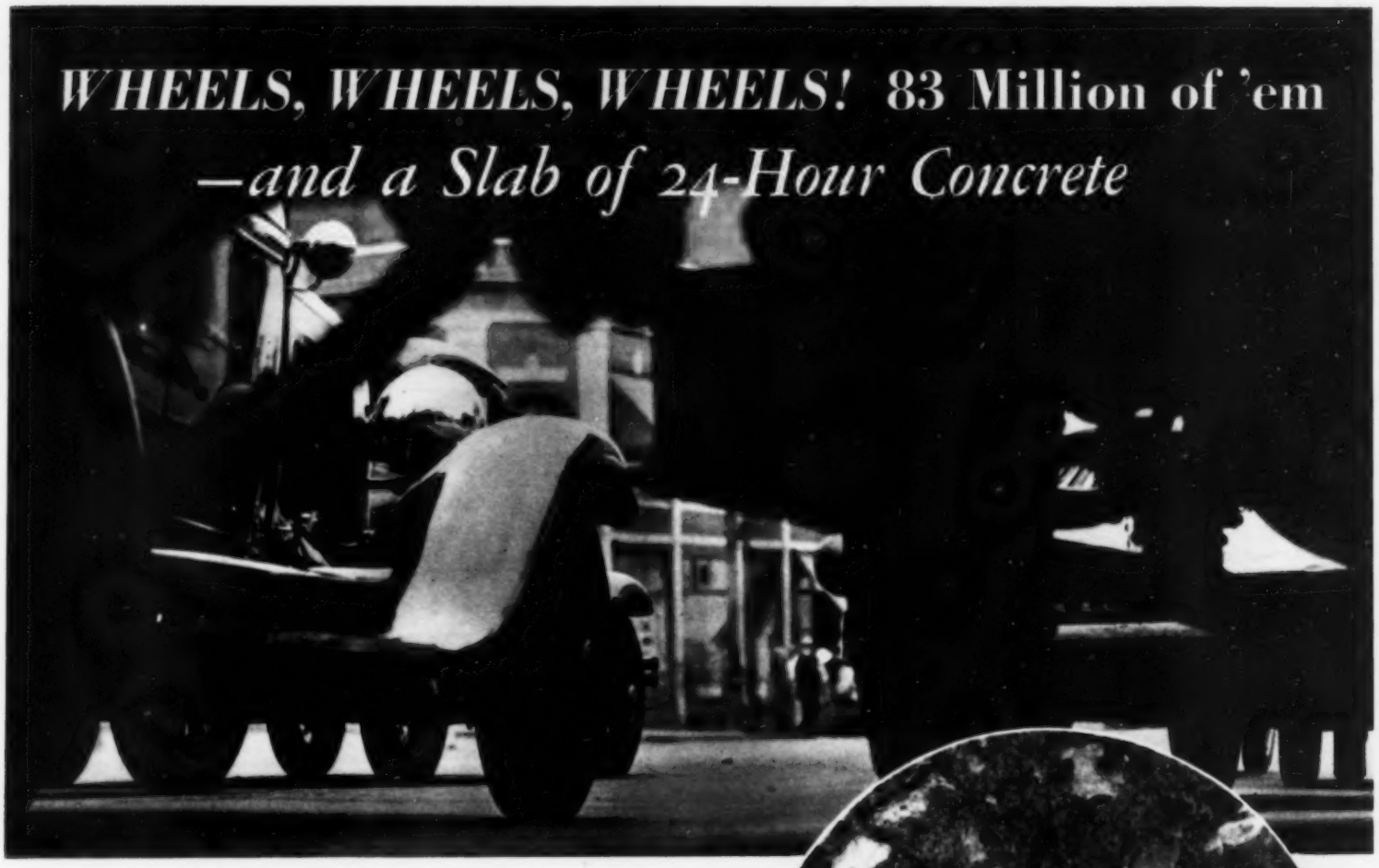


Pounded by Six-Years' Traffic on Nation's Busiest Highway, 'Incor' Concrete in Perfect Condition

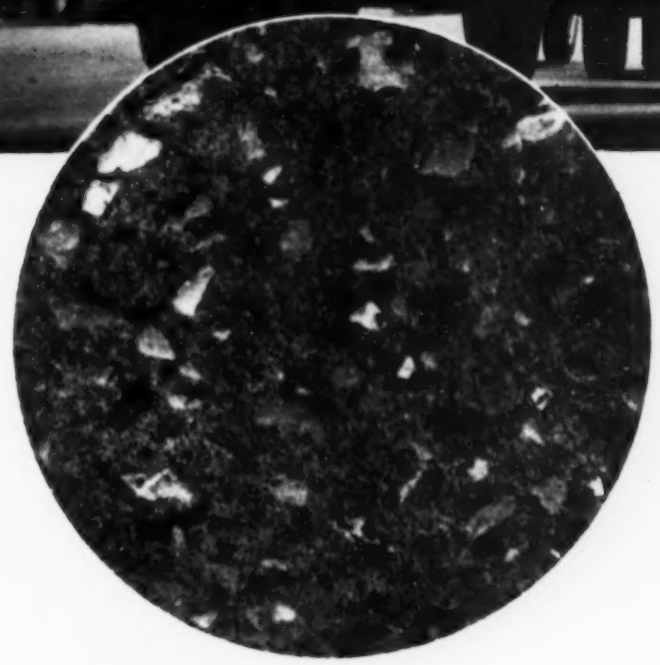
Back in 1928, shortly after 'Incor' 24-Hour Cement was first introduced, a Boston Post Road repaving job reached the heavily-traveled Main and Echo Avenue intersection, New Rochelle, N. Y. This road carries the bulk of passenger and truck traffic between New York, its suburbs and New England,—20,000 vehicles a day.

To reduce detour time, 'Incor' was used for half of the intersection. First important 'Incor' job in the New York area, engineers watched with critical eye. Yes, without question, it was gaining strength rapidly—but could it carry full traffic load in a single day?

Cylinders were tested at 24 hours; 10 minutes later barriers were down, the highway opened. Two hours later, a 30-ton steam shovel on a 10-ton carrier passed over the new concrete!

Pounded by 83 Million Wheels!

Three years later, cores of 'Incor' and of same-age ordinary Portland cement concrete were cut and tested. 'Incor' averaged 6417 pounds per sq. in., ordinary cement 5516. Last March the photograph (at the right) was made with an ordinary camera. It shows as pretty a slab of concrete as anyone would want to look at. Pounded by ceaseless traffic, 10,000 cars a day for 5 years and 8 months—83,000,000 wheels, if the slide-rule didn't slip!



'Incor' makes better concrete because it is better cement—it has to be a better-quality cement to harden in 24 hours. Hardening in one-fifth to one-seventh of the time required by ordinary Portland, 'Incor' now makes it possible to eliminate highway detours and avoid business losses caused by long-closed traffic arteries.

In concrete buildings, column forms are stripped first morning after concreting, floor forms that afternoon; one form-set does the work of several, reducing form and handling costs; financing expense reduced, revenue from investment begins sooner.

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* Reg. U. S. Pat. Off.

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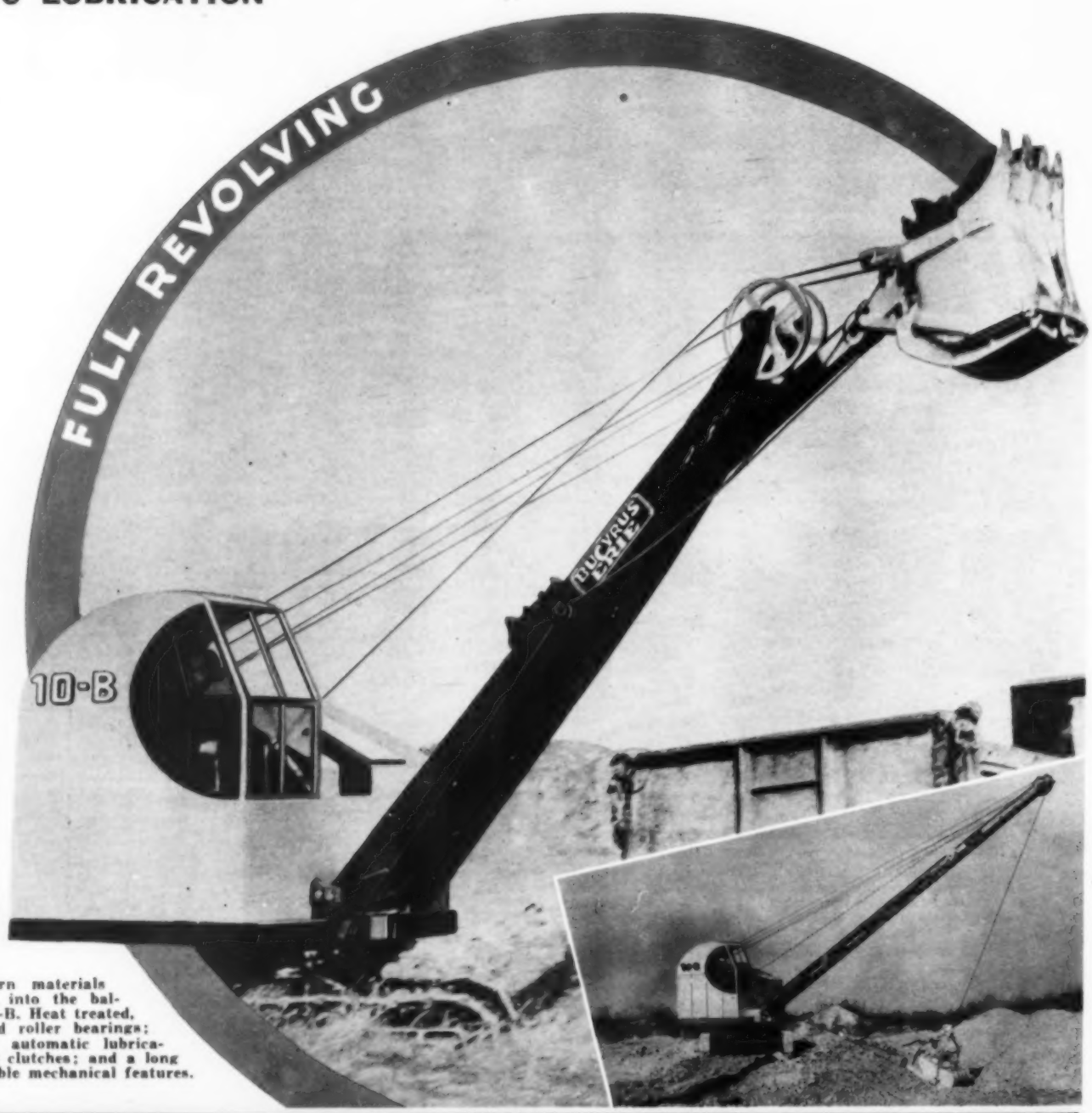
NEW *full revolving*

WEIGHS 7½ TO 8 TONS - SPEEDS TO 4¼ MILES PER HOUR - 35 TO 52 HORSEPOWER - STEERS LIKE A TRACTOR THROUGH FRICTION CLUTCHES AUTOMATIC LUBRICATION



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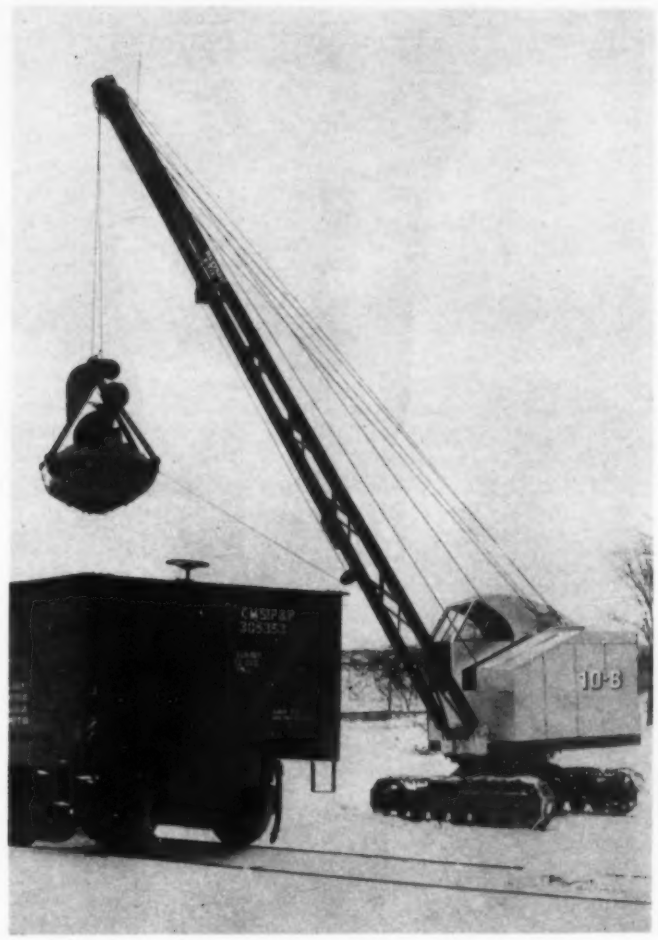

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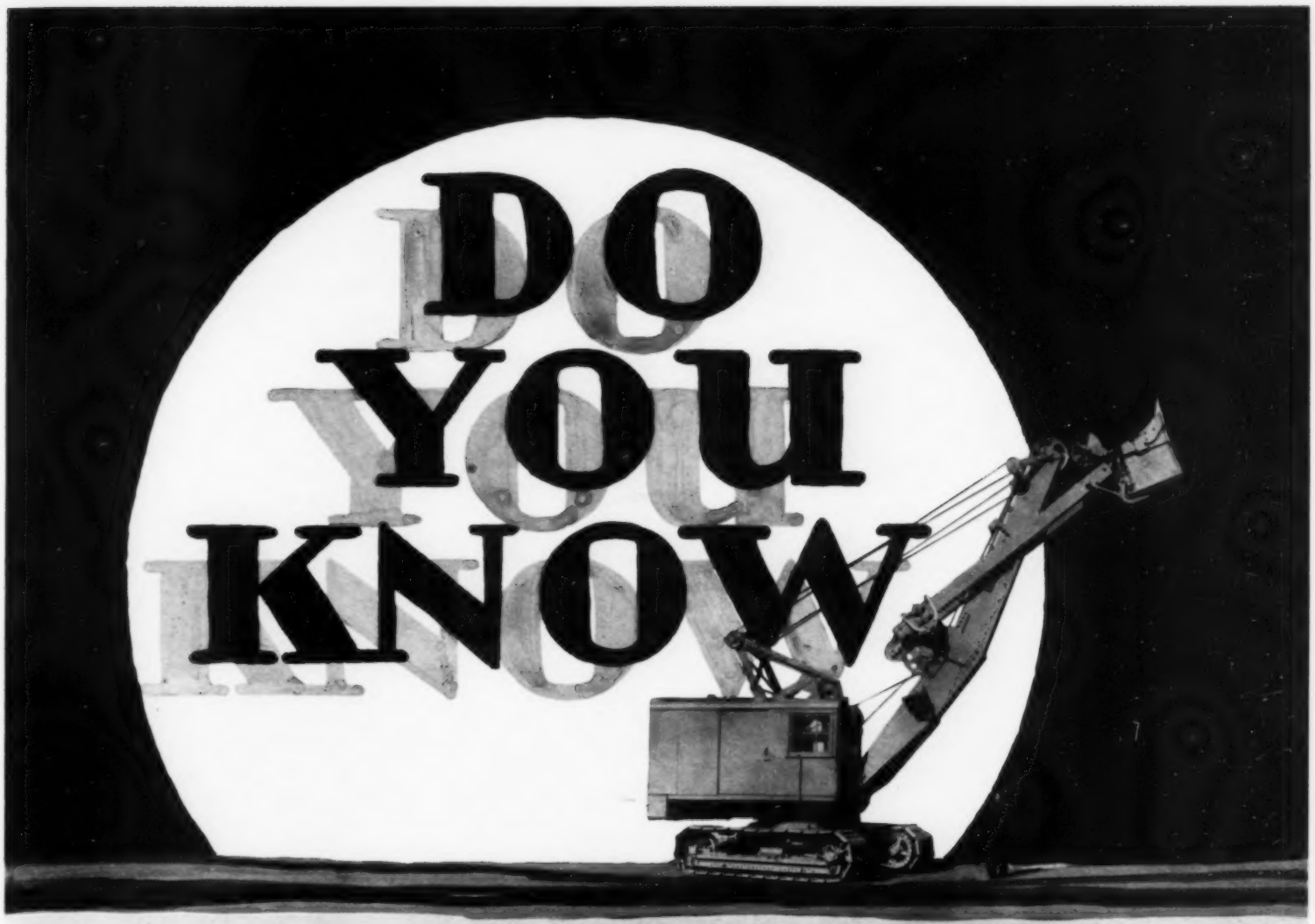

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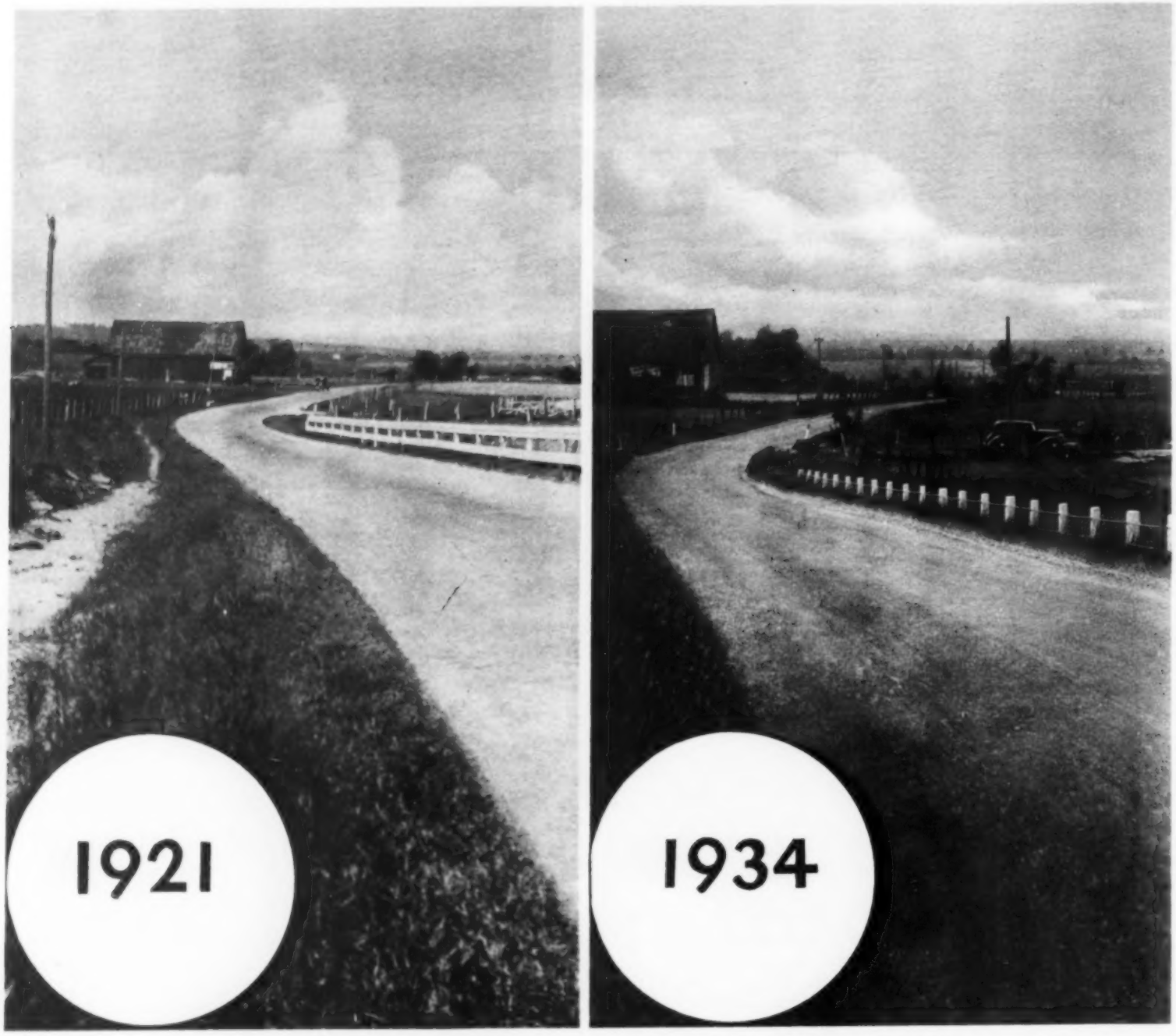

U. S. Highway No. 41, Marquette County, Michigan, Tarvia-built in 1921, while Woodrow Wilson occupied the White House. Photo at left was taken in 1924; photo at right shows present condition of the road.

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Through all the years of its development this country has kept the pioneer spirit. Aggressiveness has radiated East and West. During the past 50 year period, as construction increased, "AMERICAN" Hoisting Equipment responded to every demand, for it had Quality Engineering to offer from the very first. Most ably is it qualified for the immediate march forward in construction.

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The WRONG *way to unload pipe from a truck*

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Two years ago our research and technical staffs undertook to develop a super-pipe with impact-resistance increased to a degree which would mean maximum protection from plant to underground. After many experiments the Super-de Lavaud process was discovered and perfected, resulting in a cast iron pipe which is shatter-proofed to the extent that

IMPACT-RESISTANCE IS INCREASED 100%

Super-de Lavaud Cast Iron Pipe is centrifugally cast by a patented improved process. This process is the combined result of a basic discovery amounting to a revolutionary

SUPER-DE LAVAUD PIPE
against handling hazards

The **RIGHT** *way to unload pipe from a truck*

metallurgical change plus improved annealing. It has been standard practise in our Centrifugal Pipe Units for more than a year.

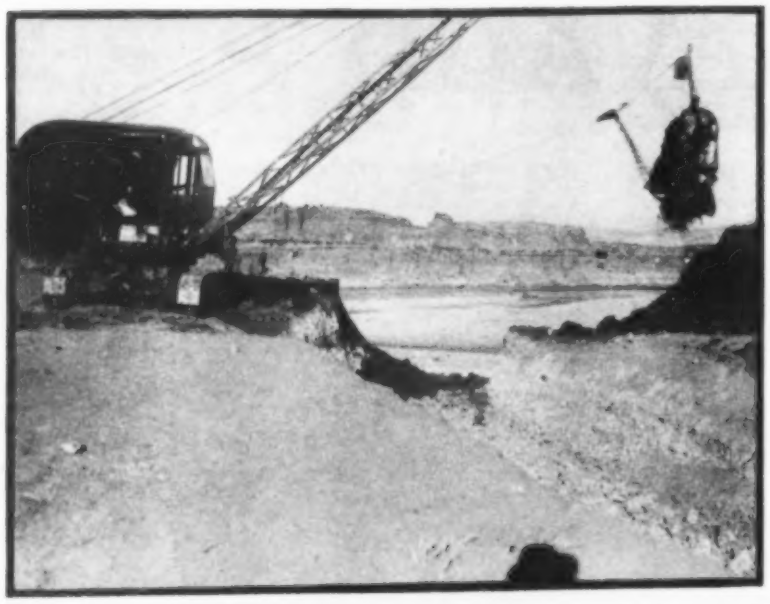
The greatly increased *impact-resistance* and the *non-shattering characteristic* of Super-de Lavaud Pipe are due to a fundamental change in metal structure resulting in a tougher pipe. These advantages have been secured while maintaining high tensile and bursting strength; also the resistance to corrosion for which cast iron pipe is celebrated. Obviously, Super-de Lavaud Pipe exceeds in all respects the requirements of the Federal Specifications Board for this product.

Send for descriptive booklet with full details.

UNITED STATES PIPE AND FOUNDRY COMPANY

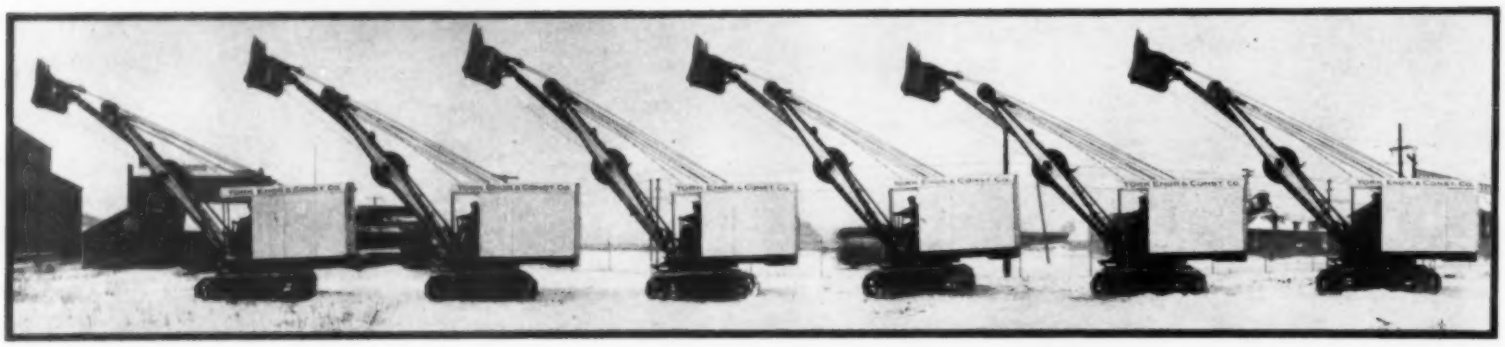
GENERAL OFFICES . . . . BURLINGTON, N. J.

FOUNDRIES AND SALES OFFICES THROUGHOUT THE UNITED STATES



STABILITY AND STRENGTH VS. WEIGHT
The new Lorain 40-37-30's are of Center Drive design, further improved to give them a Balanced Design in which their greater capacities depend on stability and strength rather than weight.

MARCHING ALONG TOGETHER



SIX LORAIN-75'S—All purchased at one time, by one contractor, for one job. These rebuilt shovels show the lasting value of a Center Drive unit—a time-tested design that retains its modernism. Lorains may get old—but they don't get out-of-date.

CENTER DRIVE +10% MORE OUTPUT + 50-75% LESS FUEL COSTS

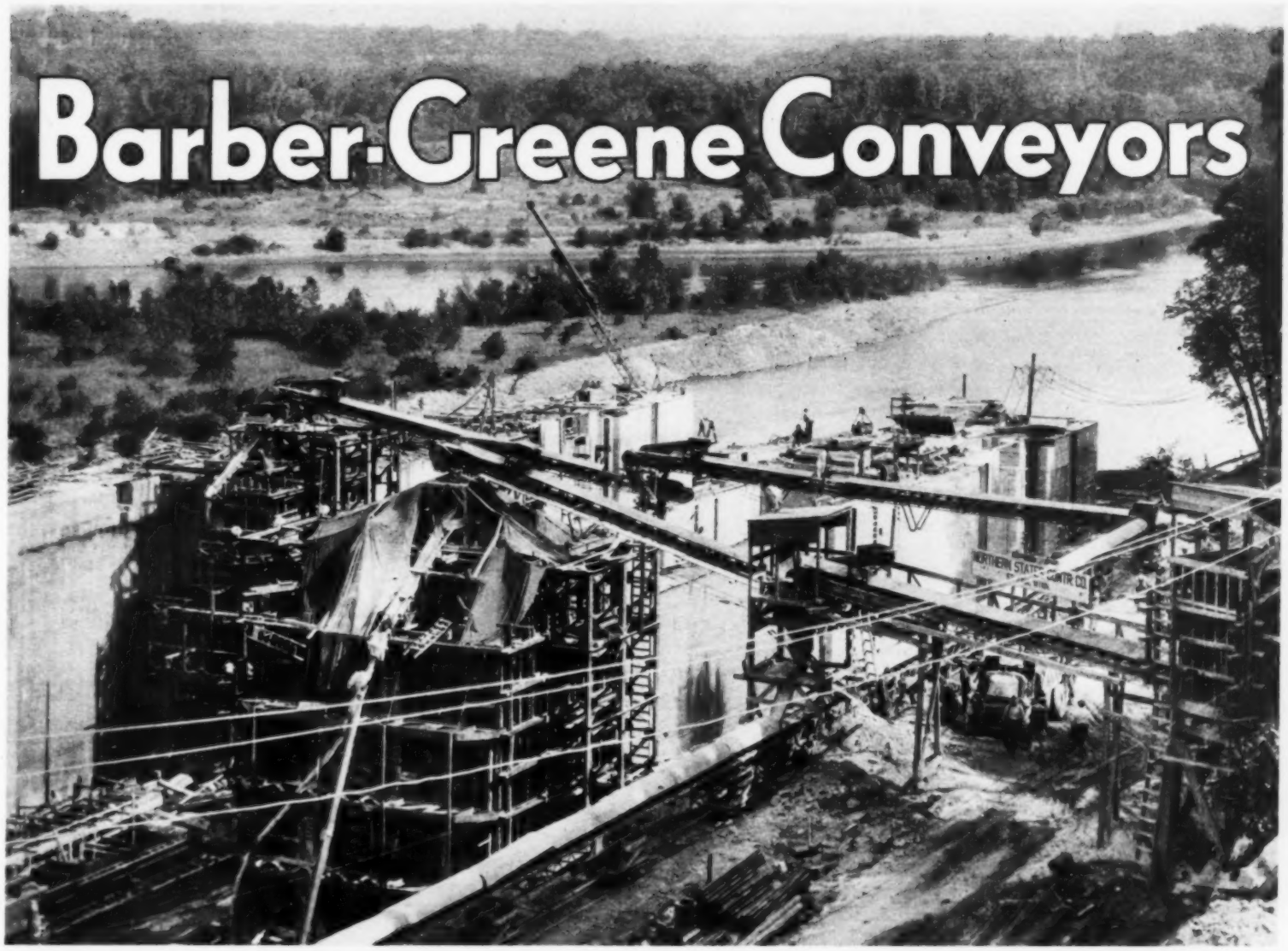
LORAINS may be old, dented, muddy, paintless, brand new or rebuilt, but they all possess one common, lasting feature—Center Drive—which is as sound, as far ahead today as when it first revolutionized shovel and crane performance. Combined with this proved feature, the Lorain 75-B now offers a modern type Diesel Motor—a combination which owners say, increases output 10 to 20%; and cuts fuel costs 50 to 75%.

BUY MODERN—KEEP MODERN—USE MODERN CENTER DRIVE LORAINS

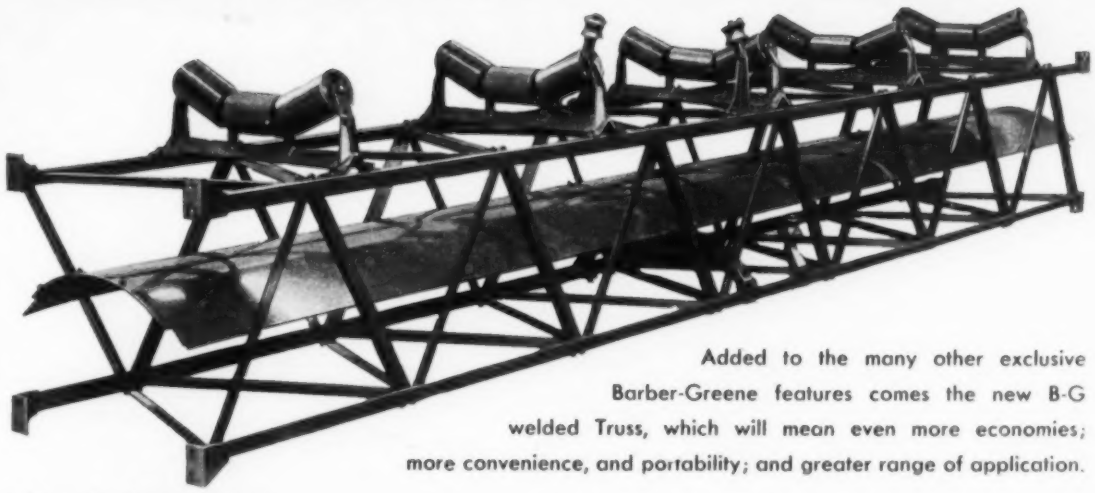
LORAIN·75B·40·37·30

THE THEW SHOVEL CO. · LORAIN, OHIO · THE UNIVERSAL CRANE CO.

Barber-Greene Conveyors



Note the unique design of the new B-G Truss giving uniform rigidity in all directions. Warren-type lateral bracing as well as side trusses with common focal points, give a staggered paneling to the opposite sides. Note the focal points of struts and chords with six members meeting at each point.



Added to the many other exclusive Barber-Greene features comes the new B-G welded Truss, which will mean even more economies; more convenience, and portability; and greater range of application.

The B-G welded Truss, which is 30" deep, will make longer spans, and longer over-hangs, thus eliminating many costly supports. Its rigid box section gives it the same great strength in all directions, making it easier to lift, and of course retaining its alignment when handled. Like all Barber-Greene Conveyors, the truss is made up of standardized sections so that it can be easily knocked down, easily transported, and easily erected. Whether your conveyor is to be erected permanently or must be changed to suit new conditions or new jobs, the B-G Truss will add materially to the many advantages of using belt conveyors.

Remember, B-G Standardized Conveyors are available in sizes to meet all normal requirements, with roller bearing, ball bearing, or plain bearing carriers, and with all necessary auxiliary equipment.

Quotations gladly submitted on complete installations, or any of the Barber-Greene parts. No obligation.

Standardized Material Handling Machines

BARBER GREENE

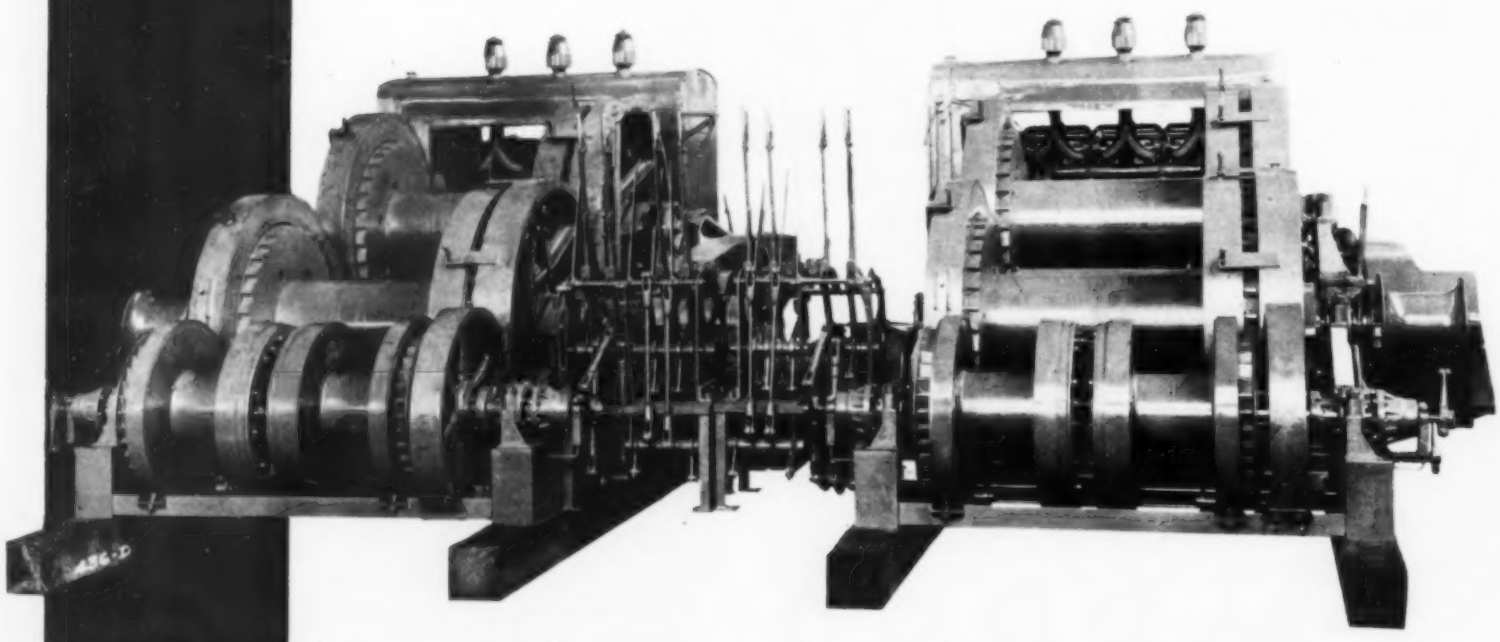
530 West Park Ave.,
Aurora, Illinois

CLYDE

350 HORSEPOWER GASOLINE UNIT

Two Clyde 350 horsepower dual units as illustrated below will be used to set the steel on the new Transbay Bridge between Oakland and San Francisco.

Construction details on these powerful hoists include such features as three speed friction clutches; ball and roller bearings for all rotating parts; each main drum equipped with a service and safety brake with increased braking area; easily controlled operating frictions; drum gears and side frames of electric furnace steel castings mounted on a rigid, electric welded base of CB section beams.



Complete information about the Clyde line of Gasoline, Steam and Electric Hoists, Steel Derricks and Clyde Whirleys will gladly be sent upon request.

CLYDE

CLYDE SALES CO.

DULUTH, MINN.

The Evidence Shows

That every single P&H with Split Second Control has reduced maintenance costs

SPLIT Second Control permits an operator to feel his way with absolute certainty. He doesn't wrestle with his machine. One finger on a control is enough to assure the perfect balance and control that means Greater Yardage at Lower Cost.

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Established 1884
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Warehouses and Service Stations:
HOBOKEN MEMPHIS JACKSONVILLE
SEATTLE DALLAS LOS ANGELES
SAN FRANCISCO

P&H

the 50th year

WHITE CONCRETE TRAFFIC MARKERS

ARE

EASY to BUILD

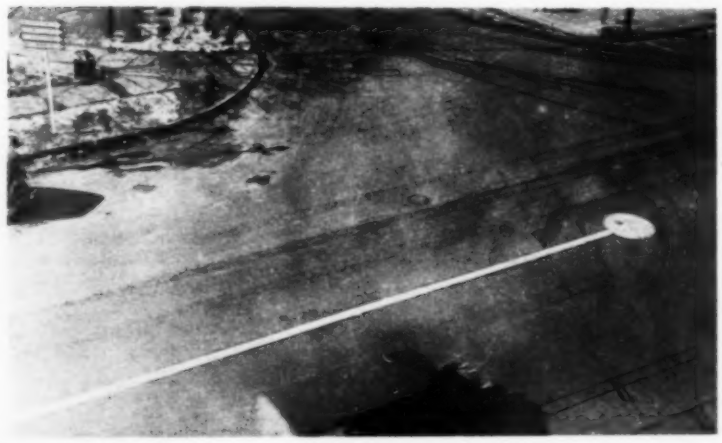
1. In this asphalt-paved street in Middletown, Conn., for example, guide lines were marked on pavement and asphalt cut out in 12" wide trench, down to concrete base.

2. The next step was to undercut the edges of the trench, on both sides, to provide a mechanical bond between the asphalt and the marker. This was a simple job.

3. Then a layer of gray concrete was placed in the trench, and scratched to give a good bond. Before its initial set the one-inch topping of white concrete was placed.

4. Next the white concrete was troweled with a steel trowel to the smooth, hard, stain-resistant surface that will keep this white marker *permanently* white.

5. Finally the completed white concrete marker was covered with stainless paper and a layer of straw, to allow complete curing and to prevent freezing.



6. And here is the completed marker. It will guide traffic efficiently, for years, with *no replacement cost.* City Engineer Allen Schaefer built it with CWA labor. (Note —while CWA stops March 31, projects like this can be carried on under the Works Division of the Federal Emergency Relief Administration—FERA.) Write Universal Atlas Cement Co. *(Subsidiary of United States Steel Corporation)*, 208 South La Salle Street, Chicago, for complete information. 162

ATLAS WHITE TRAFFIC MARKERS

Made with Atlas White Portland Cement—Plain or Waterproofed

Construction Methods

ROBERT K. TOMLIN, Editor

Established 1919—McGraw-Hill Publishing Company, Inc. Volume 16—Number 4—New York, April 1934

ONE SPAN IN PLACE, while second of three 608-ft. through-trusses has been erected on falsework along shore and is ready to be floated to piers by barges.

Bridge Trusses FLOATED *to Place on Piers*

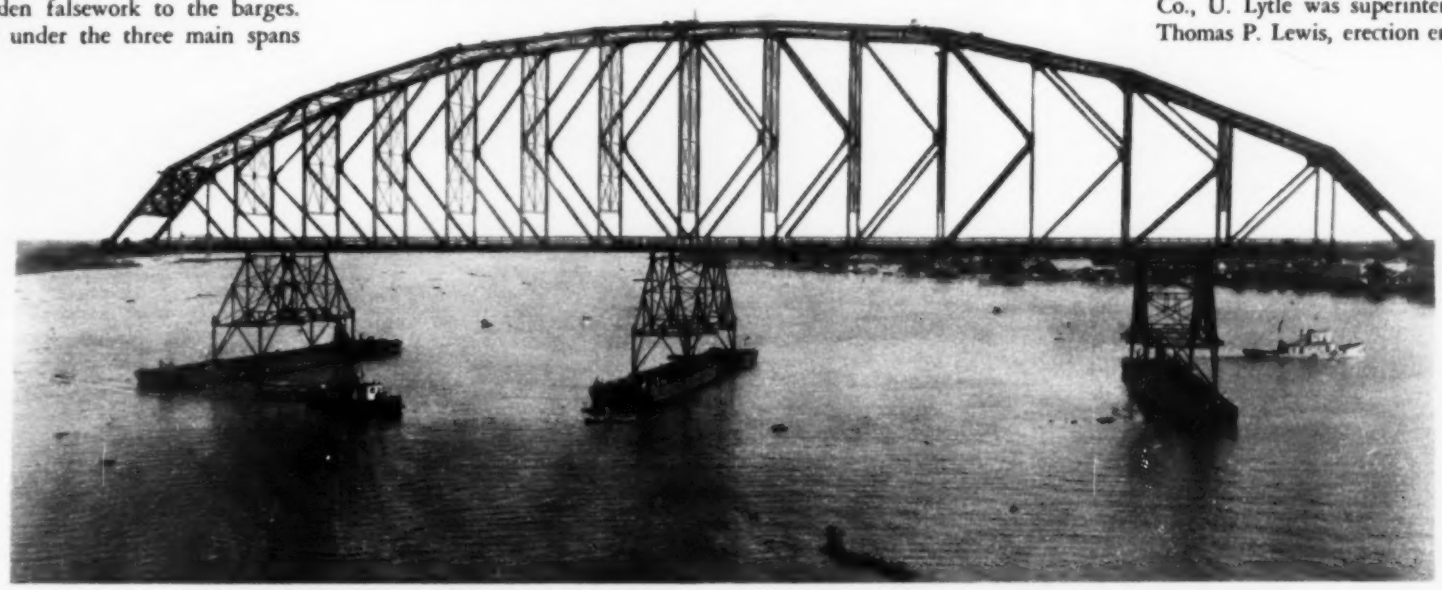
TO ELIMINATE the difficulty of constructing expensive falsework on long piles driven into the deep mud of the river bed, the Mt. Vernon Bridge Co., subcontractor for the superstructure of the new free highway bridge across the Atchafalaya River at Morgan City, La., under the Foundation Co., general contractor, erected three 608-ft. through-truss spans weighing 1,350 tons on temporary timber and steel towers 400 ft. upstream and floated each of the spans on three steel barges from this point to permanent position on the bridge seats. The towers rested on wood piles, driven in 20 to 30 ft. of water about 90 ft. from shore and the steel towers (three in number) were so built that the weight of each span could be transferred from the wooden falsework to the barges.

Water under the three main spans of the bridge varies in depth from 30 to 70 ft., and the bottom of the river is covered with 30 to 40 ft. of soft mud. The deeper of the two river piers extends 176½ ft. below low water, a depth greater than the foundation of any other bridge yet completed.

Falsework constructed parallel with the shore upstream consisted of six timber towers in addition to the three steel towers. The steel towers were connected to the barges by adjustable posts with a total adjustment of 17 ft. in 4-in. intervals to take care of the rise and fall of the tidal river and varying heights of the bottom chords above the river. Each of the two end spans has a grade of 10 ft. in its length; the falsework was built to this grade and was leveled up with pony bents for the middle span after the end spans had been erected.

Two tugs towed the three barges to the bridge site, where their movements were controlled by lines from the piers and from two upstream anchors to hoist engines on the barges. The superintendent directed all movements by telephone from the center of the span. Less than 2 hr. was required to float each of the spans from its falsework to final position on the piers.

N. E. Lant was bridge engineer of the Louisiana Highway Commission, and P. V. Pennybacker was resident engineer. For the Mt. Vernon Bridge Co., U. Lytle was superintendent and Thomas P. Lewis, erection engineer.

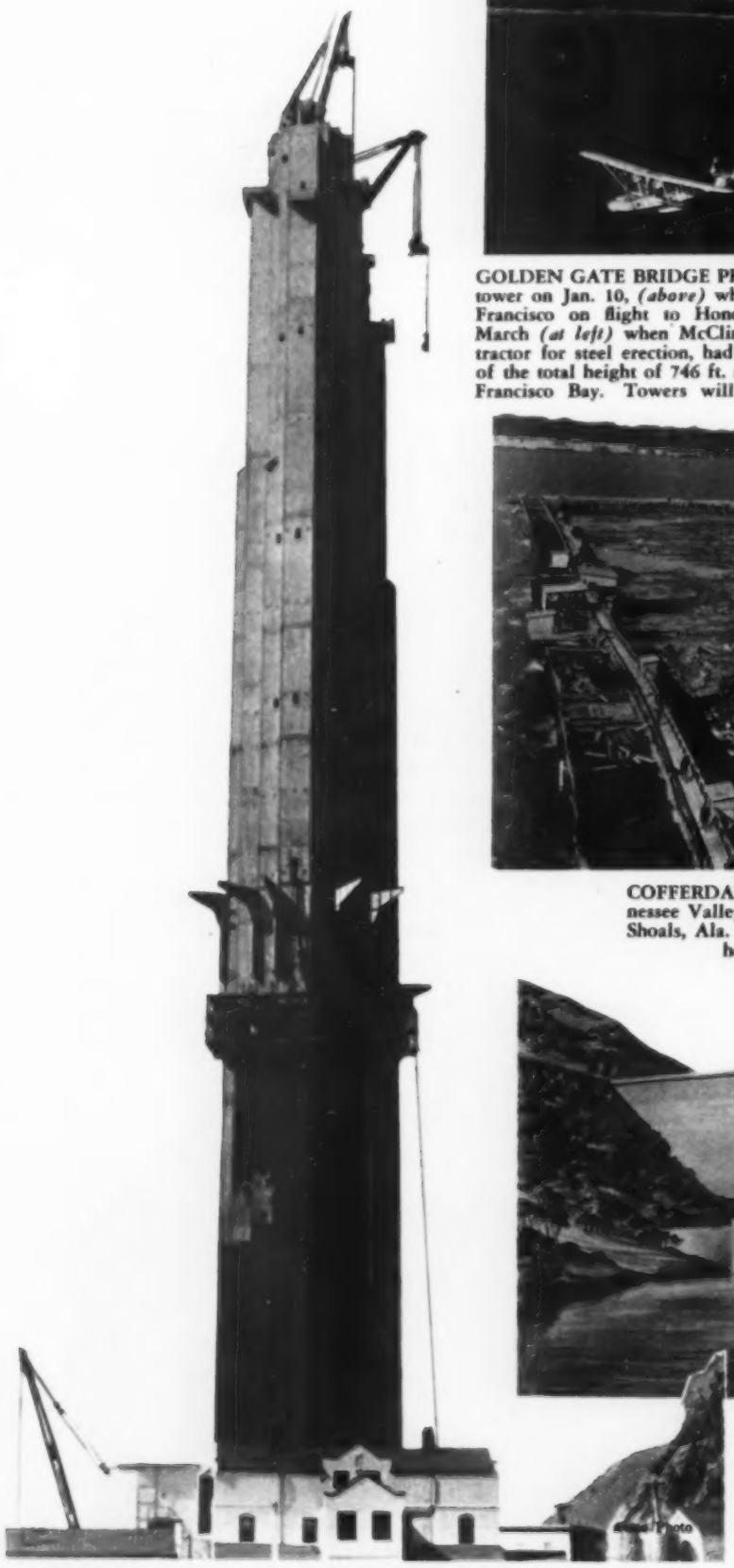


THREE BARGES float one of the three 1,350-ton spans across Atchafalaya River for seating on concrete piers. Towers support steel structure, completely erected on falsework, to give maximum clearance of 58 ft. below bottom chords.

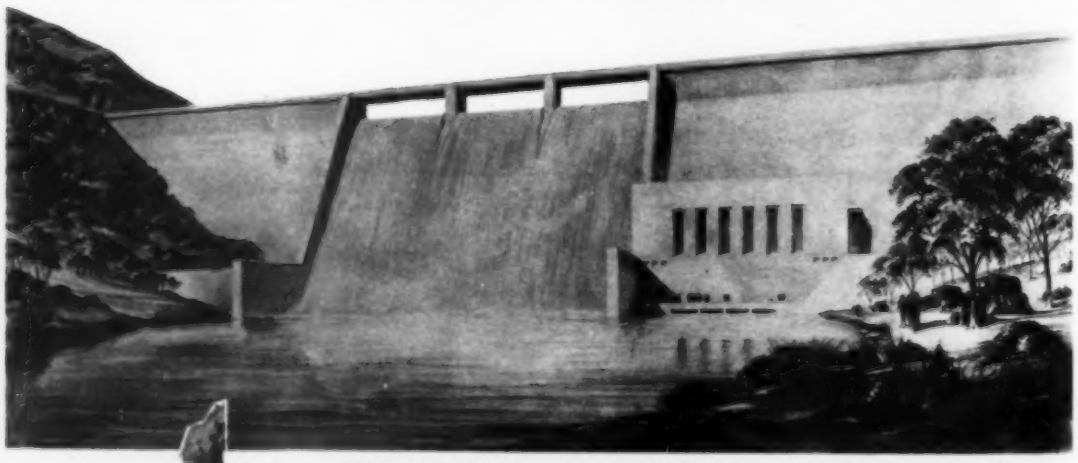
This Month's

"NEWS REEL"

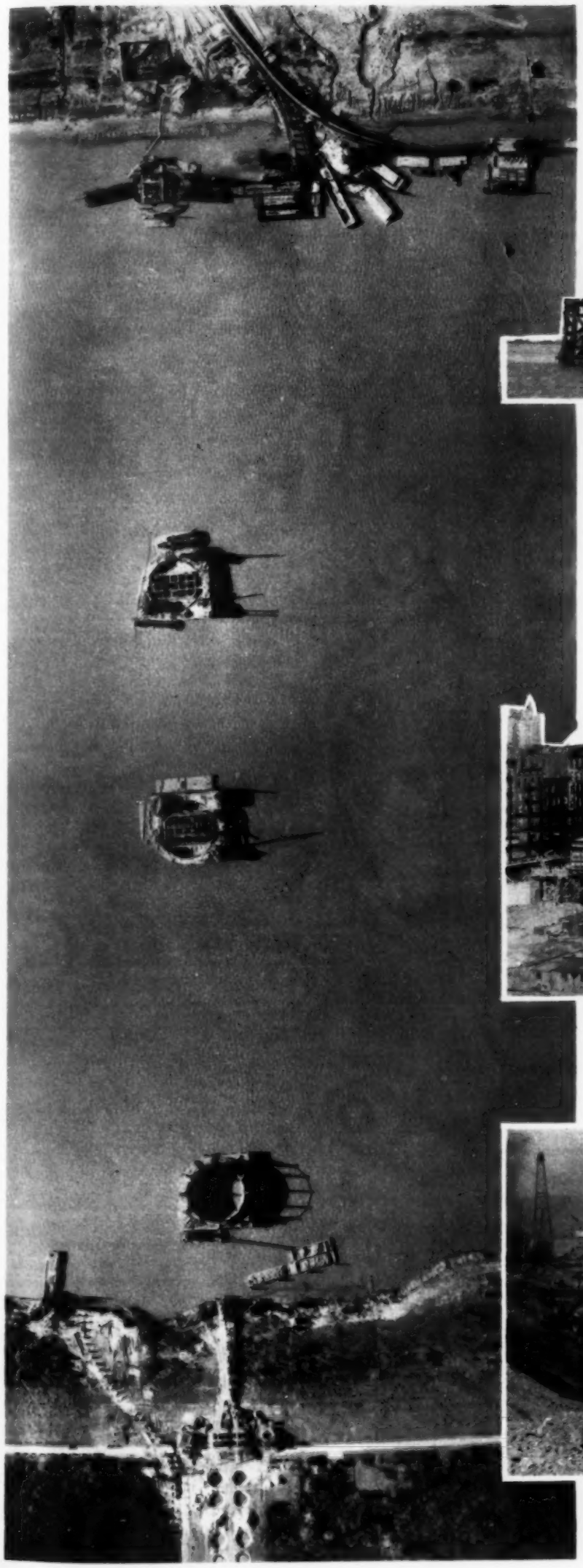
GOLDEN GATE BRIDGE PROGRESS. Marin County tower on Jan. 10, *(above)* when Navy planes left San Francisco on flight to Honolulu, and during mid-March *(at left)* when McClintic-Marshall Corp., contractor for steel erection, had carried structure 644 ft. of the total height of 746 ft. above water level in San Francisco Bay. Towers will support 4,200-ft. main suspension span, world's longest, with clearance of 220 ft. above high water. Two main cables are 36⅛ in. in diameter, and contain total of 80,000 miles of Roebling wire. Each tower comprises two steel posts, built up of rectangular cells in groups numbering 97 at bottom and 19 at top. Each tower leg varies in steel area from 7,527 sq. in. at bottom to 3,859 sq. in. at top.

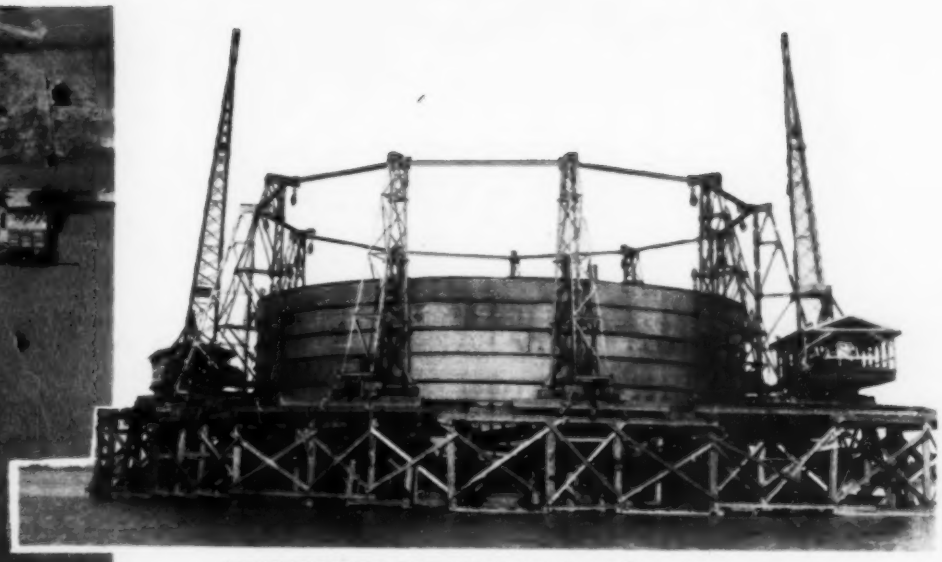


COFFERDAM UNWATERED at site of $22,000,000 General Joe Wheeler dam which Tennessee Valley Authority is building on Tennessee River 15 mi. above Wilson dam at Muscle Shoals, Ala. Electric power shovels are excavating riverbed to provide foundation for power house. Across river, in background, construction is in progress on lock.

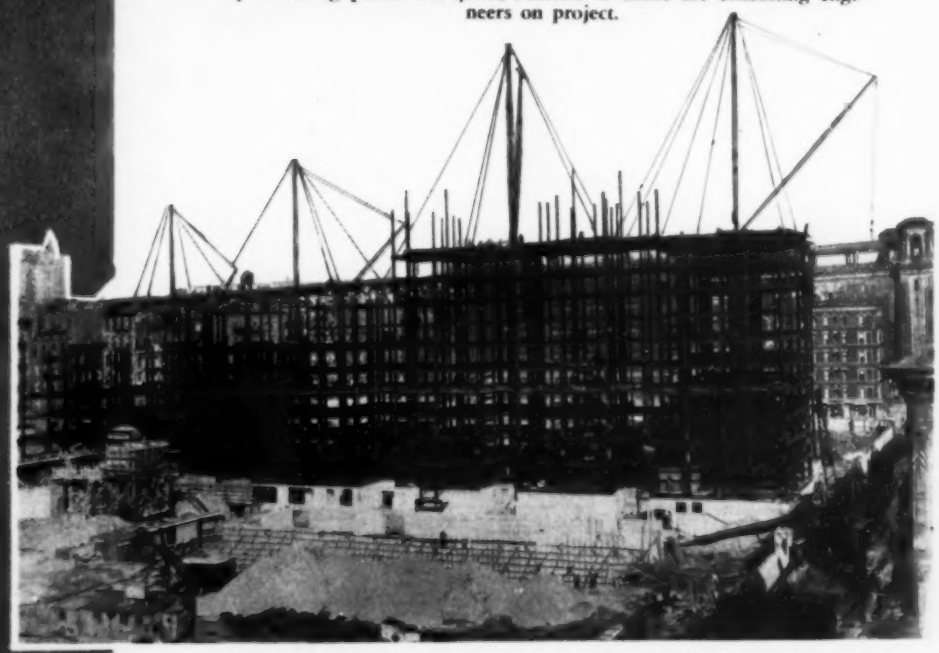


NORRIS DAM DESIGN, as officially adopted by Tennessee Valley Authority, Arthur E. Morgan, chairman, is pictured in artist's drawing. Gravity structure across Clinch River, in Tennessee, costing $34,000,000 will have height of 250 ft., crest length of 1,700 ft. and will contain about 1,000,000 cu.yd. of concrete. Built-in spillway forms center of dam, with power house at right and highway along top. Dam was designed under direction of John L. Savage, chief designing engineer, U.S. Bureau of Reclamation.

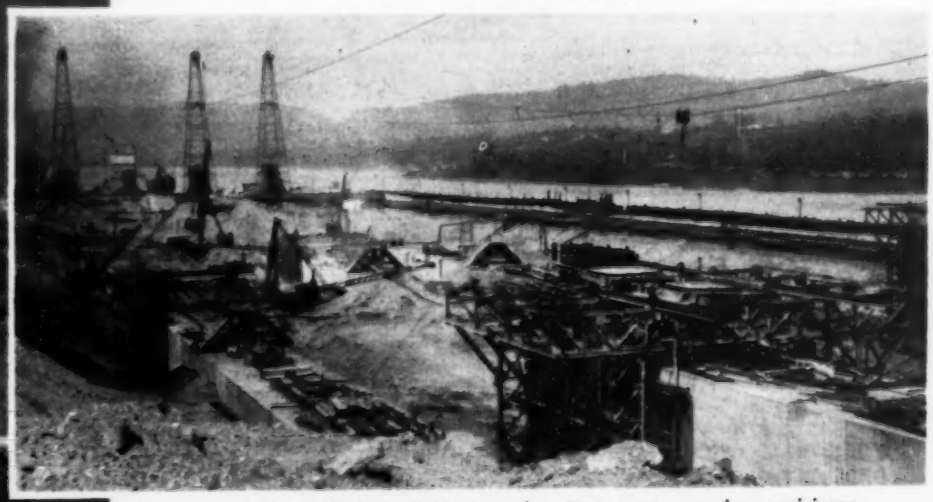




SUBSTRUCTURE FOR MISSISSIPPI RIVER BRIDGE, at New Orleans, consists of river piers *(at left)*, of which four of a total of five are nearing completion. Piers are built by sinking concrete caissons through artificial "islands" of sand deposited within hollow steel shells *(above)* 121 ft. in diameter. Construction by Siems-Helmers, Inc., of St. Paul, Minn., requires falsework on 135-ft. wooden piles driven in circle and capped with heavy timbers. Caisson concrete is poured by 4-yd. floating plant. Modjeski, Masters & Chase are consulting engineers on project.



KNICKERBOCKER VILLAGE, great limited-dividend housing project financed by $8,000,000 RFC loan and under construction by Fred F. French Co., replaces slums on 5-acre plot on lower East Side of New York City. Steel skeleton for first half of one of two fireproof houses (containing in all 1,630 apartments of more than 6,000 rooms) is nearing completion in this photograph. Two structures cover 96,323 sq.ft., or 43.8 per cent of total area.



MONTGOMERY LOCKS, more than 50 per cent complete, anticipate construction of Ohio River Third Fixed Dam at this point, below Beaver, Pa. Locks provide for two chambers: 110x600 ft. and 56x360 ft. Three cableways place 250,000 yd. of concrete. Booth & Flinn Co., Pittsburgh, contractor.

First of a Series of Four Articles:

PUTTING SYSTEM TO WORK IN FIELD AND OFFICE

1 . . .

Simple Methods for Job Unit Costs

By GEORGE E. DEATHERAGE
Superintendent of Construction, South Charleston, W. Va.

THE AUTHOR

¶ MR. DEATHERAGE's construction experience began in 1909 with the McKensie Mann Co., of Winnipeg, as inspector and force account man. Then followed six years' service in the construction division of the U. S. Steel Corporation at Duluth, as foreman, assistant general foreman, general foreman and general yardmaster on operation.

● He moved into the contracting field in 1916 with Arthur G. McKee & Co., of Cleveland, in charge of blast furnace and power house construction. During this time he spent three years in India as general superintendent of construction for the Indian Iron & Steel Co. On returning to the United States in 1920, he developed machinery for the mechanical mucking of tunnel headings.

● Again resuming work in the contracting field, he spent several years in West Virginia on numerous small projects and then became superintendent of construction, first for the H. K. Ferguson Co., of Cleveland, and later for a large chemical corporation. In this work all new construction has been under his direction, including installation of equipment, piping and electrical work.

ACCOUNTING RECORDS are valuable only when they are used as a basis for action. The foregoing sentence might be said to cover broadly all the requirements for an efficient and successful system to record daily and weekly unit construction costs. Any system which is to be used as a basis for action must first take the time element into consideration and furnish correct costs early enough in the course of the work to permit job control before the job has been placed in the red through inefficient personnel or methods. It is of no use to lock the stable after the horse has been stolen. Similarly, it is of no benefit to find out that money has been lost on the job after the work is complete. It is too late, then, to do anything about it, except to find it a logical excuse for a headache.

The construction industry, more than any other, needs an accurate and speedy method of placing unit costs in the hands of the supervisors not later than three or four hours after the ending of the previous shift. This is because construction work is not highly repetitive in action in so far as duplication of work is concerned. A great many jobs are so broken up that they are performed only once during the life of the work; each day's work is of a different character from that of the day previous. If there is to be any correction of method or organization, it must be performed immediately.

"A great deal remains to be done in educating the small contractor to make his decisions and estimates on actual costs, rather than on the 'hunches' of himself or his foreman."

● *Daily Cost Reports*—The larger successful contracting concerns early discovered this and evolved a system of daily unit cost reports that gave them this information. They, however, are in the minority and a great deal remains to be done in educating the small contractor to make his decisions and estimates on actual costs incurred, rather than on the "hunches" of himself or his foreman. It is presumed that some of the hesitancy to institute daily unit cost reports on a comprehensive scale has been caused by the general idea that such a system necessarily means an increase in clerical force and overhead. This is decidedly not true. Cost systems are in effect that, because of their very simplicity, do not require any increase in the timekeeping office.

● *System Explained*—An illustration of such a system is the one put out by the McCaskey Register Co.; it is used by the writer to record and check costs on construction for a large corporation engaged in construction work of a very complex nature, including general building work, machinery installation, piping, electrical work, etc. A description of this system in successful use follows:

Each foreman on the job keeps and records the time of all men under his charge, but instead of entering it in total hours in a standard time book, he enters it in a multi-copy book of pocket size containing forms in triplicate, as illustrated. This pocket register reminds one very much of the old time register used at the corner grocery The time and the distribution of the men working under the foreman's direction are posted on this slip for each different job done during the shift. That is, each specific job during the day is charged with the time of each individual working on it. This charge is posted in the foreman's book at the completion of the work being done. If a carload of brick is being unloaded and it takes 6 men 4 hr. to complete the work, that specific job has a ticket made out for it at completion.

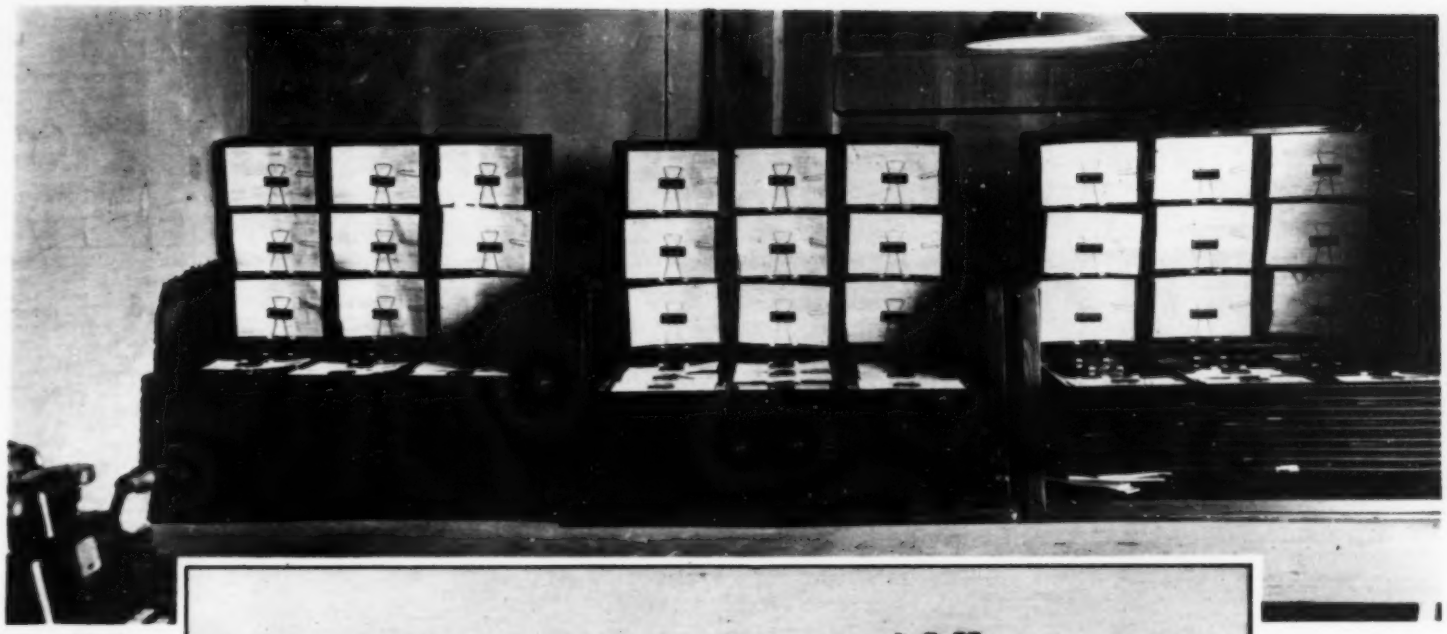
This ticket bears the workman's number and the hours worked on that job. The foreman does not enter rates or make extensions. That is done by the timekeeper at the end of the shift. As the foreman makes the ticket out as the work is performed, turning the tickets in at the end of the shift, he is not depending on his memory, after the day's work is complete, to record what he has done during the day. This method insures accurate costs.

The original and duplicate tickets are turned in to the timekeeper at the end of the shift, the foreman retaining the third copy for his records. The number of hours shown on the tickets must check with the time-clock records for the total number of hours worked by each man. This is a double check on the time records and saves the timekeeper from checking men in the field.

"It is of no benefit to find out that money has been lost on the job after the work is complete. It is too late, then, to do anything about it, except to find it a logical excuse for a headache."

The timekeeper, with the tickets in his hands, fills in the rate for each individual man, totals it for that ticket, and adds all the expense for that specific ticket to the "Balance Bro't Forward," bringing the entire amount down to the "Total" at the bottom of the ticket, which is the total amount spent to date on that specific job. This total

"The construction industry, more than any other, needs an accurate and speedy method of placing unit costs in the hands of the supervisors not later than three or four hours after the end of the previous shift."



VISUAL REGISTER (*above*) for field office. Time-slip forms, filled out by foreman for each job, are filed behind spring clips. Last ticket is always on top, showing total cost. One clip is provided for each classification of work.

CONST. DIV.

Date 1-7-35

Labor of Bricklayers Dept.

F. W. O. 840 For Chemical Building Charge 653-19-35

WORKMAN	DESCRIPTION OF WORK	HOURS	RATE	AMOUNT
	BALANCE BROT. FORWARD			160 00
1780	Mason	8	1.50	12 00
1779	"	8	1.50	12 00
1540	Hod-Carrier	9	.60	5 40
1530	Laborer	8	.40	3 20
1522	"	8	.40	3 20

E-75

Layed 2100 Brick TOTAL 195.80

IF ANY PERSON NOT AUTHORIZED SIGNS THIS CHARGE SLIP IT WILL NOT BE ENTERED.

Signed H. A. Jones

Position Mason Forman

to date 10,000
unit cost 19.50

McCASKEY, ALLIANCE, OHIO

TICKET (*left*), in triplicate, from foreman's multi-copy book, shows time and distribution of labor charged against each specific job. Timekeeper enters rates and makes necessary extensions at end of each shift.

is posted next day as "Bro't. Forward," which gives a running total for all expense on any job.

The tickets, as totaled by the timekeeper, are filed behind a clip in a McCaskey visual register (see photograph), a clip being provided for each classification of the work. The last ticket is always on top which means that the total amount of money spent to date can be read directly off each ticket at a glance. Everyone has seen the manifold books used by the small retailer to charge his customers with goods purchased, the ticket showing a running total of the amount of the bill; that is all there is to the system described. Instead of charging a person with a sack of flour and a loaf of bread, the foreman charges so much time to each job covered in the cost on which he does work. He charges so many energy units at so much an hour.

● *Responsibility* — It is the writer's practice to make the carpenter foreman solely responsible for all carpenter work, the iron worker foreman for all iron work, etc. This means that if some other individual charges time against his work by placing a charge ticket against it, it is up to the foreman to see that he is not being overcharged. Experience has shown that the men in charge of the work watch their costs very closely and woe betide the person who files an overcharge ticket against their work.

A moment's examination of the tickets filed against any piece of work during the shift not only shows the name of the foreman who filed it, but what he was doing, and the number of the individual who did the work. The system has the advantage of enlisting the foreman's direct cooperation on costs. There is no dodging responsibility here. Each foreman can examine the costs on his work any time during the day. If he has a complaint to make as to the character of the charges being made against him by others, he has recourse to the job superintendent. If injustice has been done, the incorrect charge can be easily transferred to the right case by merely making out a transfer ticket showing the amount of money and the reason for the transfer.

● *Unit Costs*—Payrolls are made up directly from the daily tickets, as is also the daily distribution, if that is required; otherwise, the duplicate tickets are sent to the main office to serve that purpose. The amount of the work performed by each foreman can be posted on the ticket in the lower left-hand corner and a running total kept of that completed to date. The unit cost of the work is therefore obtained by a simple calculation. If such work as piping is being done, on which the amount of work is not easily measurable for any one shift, a running total of man-hours is posted and the cost of the work figured in percentage of the man-hours carried in the piping estimate.

Should the job be large enough to carry a field engineer, he can prepare a daily quantity report of the work performed during the day, from which a daily unit cost report on all classifications can be prepared for the information of the superintendent. Any job, therefore, can have the benefits of accurate daily costs at a minimum of expense. One time-keeper can take care of 100 men easily, computing all the costs for the day and posting them to the daily cost report.

The superintendent can walk into the time office any time during the day and read the total for each job from the last ticket, figuring his own units from his estimate of the work performed. This puts real job control costs at his finger tips when he wants them.

● *Results*—It is the writer's experience that enlisting the aid of the foreman on the job in keeping unit costs and giving him free access to them tends to develop in him a meticulous precision of observation, measurement and statement quite alien to previous cherished belief. Foremen ultimately exhibit an almost shocking insensibility to general opinions not based on facts and, having practically supervised all of the charges posted to the work under their charge, realize that the responsibility for making a profit for their part of the work rests solely with them. It gets action, and that is what is intended.

Next Month—The second article in this series by Mr. Deatherage will discuss "Preparing Bills of Material for Complex Installations."

San Rafael 450-Ft. Suspension Bridge Has

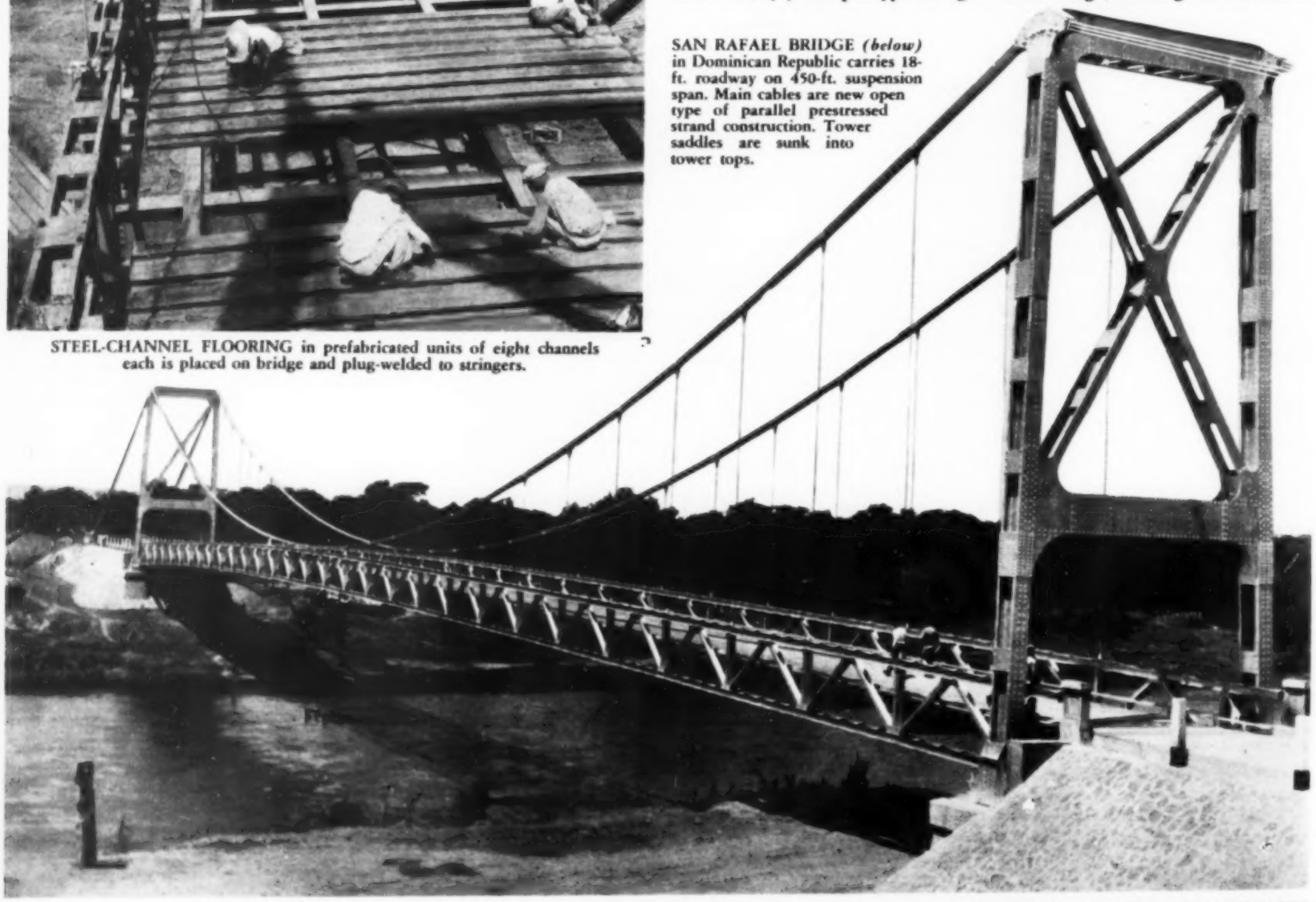
Improved Structural Details

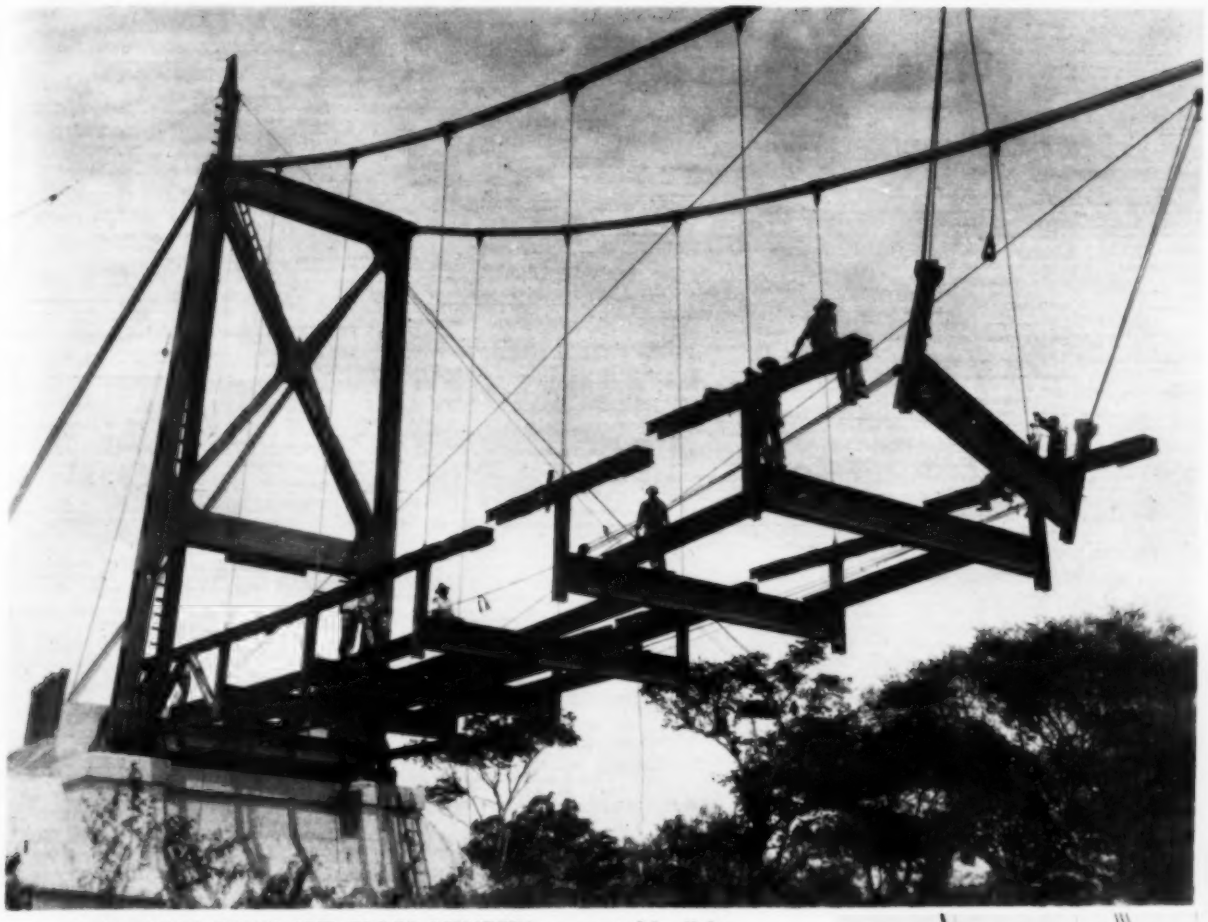
STEEL-CHANNEL FLOORING in prefabricated units of eight channels each is placed on bridge and plug-welded to stringers.

IMPORTANT innovations in design and rapid erection with native labor distinguished the construction of the San Rafael suspension bridge across the Rio Yaque del Norte in San Domingo by John A. Roebling's Sons Co. for the Dominican Republic. The bridge, which has a span of 450 ft., provides two 9-ft. lanes for highway traffic and forms an essential link in the republic's highway program. Outstanding features of the design are: (1) An interlocking steel-channel floor system which saved 122 tons in the dead load; (2) an open-type arrangement of the parallel prestressed wire-rope strands which make up the cables; and (3) a more logical treatment of the tower saddles by building them into the structural steel towers instead of placing them on top, as prescribed by previous practice. All of these features are new to suspension bridges.

Through these innovations, the bridge gained in simplicity of appearance and of structural detail, facilitating erection with native labor in 10 weeks. Lack of transportation facilities to the site was an important influence in the design, dictating that no erection

SAN RAFAEL BRIDGE *(below)* in Dominican Republic carries 18-ft. roadway on 450-ft. suspension span. Main cables are new open type of parallel prestressed strand construction. Tower saddles are sunk into tower tops.





STIFFENING TRUSS AND FLOOR MEMBERS are erected by light hoisting falls attached to main cables. Suspenders of suspension system are pinned to reinforced webs of vertical posts.

piece should exceed 21½ ft. in length or 3 tons in weight. These requirements governed the number and location of splices in the towers, which are of the fixed flexible-column type, 57 ft. 11 in. high.

Tower Saddles—Up to this time, so far as is known, all main saddles have been placed on top of the tower columns, either to remain protruding or to be covered by some ornamental treatment. This location produces eccentric wind loadings at the tower top, usually transmitted by heavy steel castings to the tower proper. On the San Rafael Bridge the saddle is placed in the tower structure in a position which brings the center line of the cable into coincidence with the intersection point of the column, top strut and diagonal. This design causes all resultant forces to intersect in a common point and produces a clean-cut tower top.

Each of the two main cables consists of nine parallel 1⅜-in. galvanized prestressed bridge strands arranged in three layers of three strands each, with space between the strands. To maintain this arrangement at the towers, the saddles are made up of a grooved lower section for the three bottom strands and grooved fillers for the intermediate and upper strands. The saddle is retained in a notch between steel plates of the tower structure.

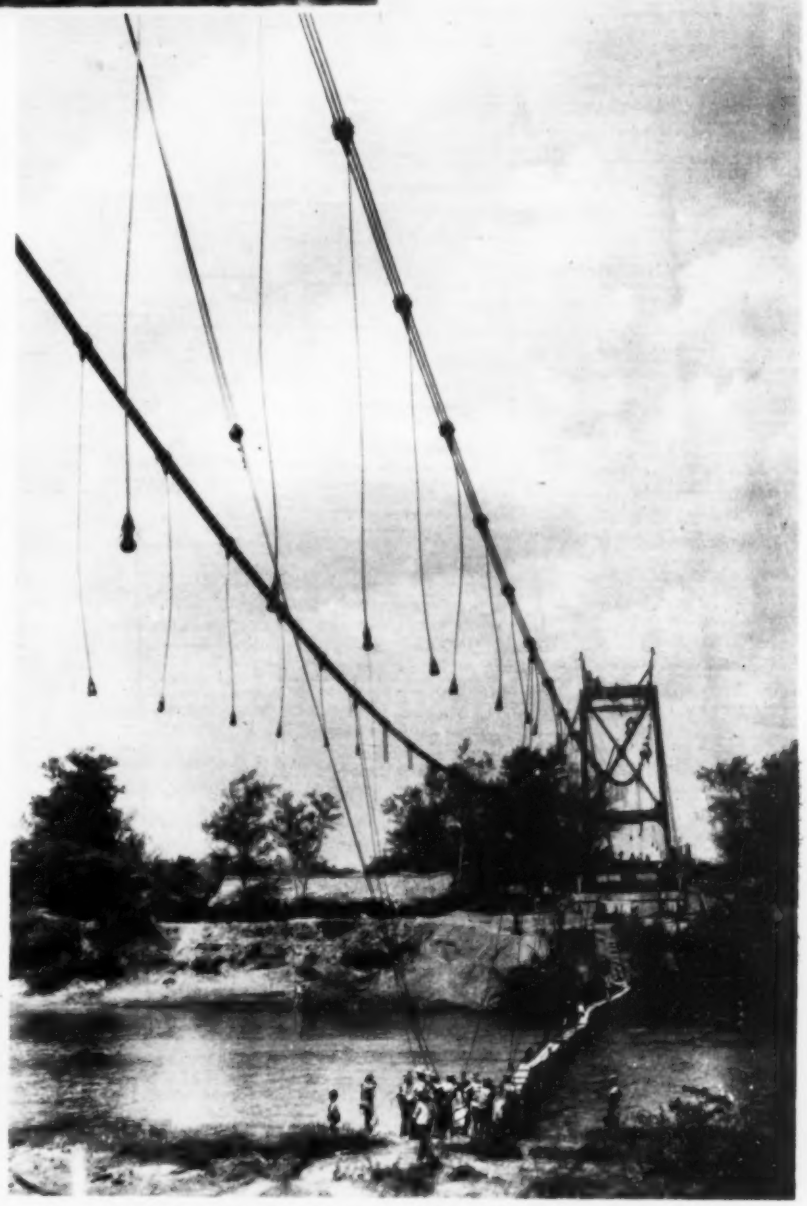
A steel casting, containing three grooves on 3-in. centers for the three lower strands of the cable, forms the lower section of the saddle. These grooves are finished to a radius of 55¾ in., equal to 40 strand diameters. The vertical load of the main cable is transmitted to the column through eight 2¼-in.-diameter turned and ground key bolts.

To carry the second and third layers of cable strands, the design provided saddle fillers of reinforced zinc, cast to correct radius and set on top of the sections already in place. The entire assembly was covered with a weatherproof steel hood.

Open-Type Rope-Strand Cables—Unlike prior structures incorporating suspension cables of parallel twisted wire strands, the San Rafael design does not bind the strands of each cable closely together but places and holds them far enough apart to permit ready inspection at all times and painting whenever it is needed. The open construction was adopted primarily to save wrapping costs and facilitate inspection and maintenance, but the arrangement possesses other advantages. It increases the apparent diameter of the cable about 80 per cent, accentuating the graceful cable curve and lending added ruggedness to the appearance of the structure. Because the strands do not bear against one another, strand adjustments are easily made. Cable band pressures are multiplied by the number of strands in a horizontal layer, in this case three-fold. As a result, lower tension in the bolts is permissible, or conversely, with an equal total bolt tension, three times the gripping action is obtained.

Wire-rope strands for the San Rafael Bridge were prestressed, cut to exact length and socketed at the Roebling plant. As the prestressing tension was about one-half the ultimate strength of the strand, each strand was subjected to a proof test greater than the working stress which the material would undergo in service. While under dead-load tension, each strand was measured to exact length, reducing the necessity of field adjustment to a minimum. Furthermore, while under tension, the exact locations of center lines of saddles and cable bands were determined and marked on the strand, and zinc buttons were cast on the strand on each side of the saddle position. After the strand had been raised into the saddle on the bridge tower, the buttons were shimmed against bearing blocks extending from the saddle. These shims provided minute strand adjustment and assured that the strand would not be disturbed by subsequent adjustments of other strands.

Cable Bands and Suspenders— An efficient articulated cable band comprising four grooved slabs turned in vertical position and six bolts (from one of



READY TO RECEIVE FLOOR STEEL. Cable bands and suspenders have been installed in preparation for next erection operation.

which the suspender hangs by two plate links) was developed to grip the nine strands of the cable. The cross-section of the clamp is only slightly larger than that of the main cable, eliminating noticeable lumps at the panel points.

Prestressed bridge strands 1⅛ in. in diameter serve as suspenders. They are fitted with closed sockets at the upper ends and open sockets at the lower ends, which pin directly into the reinforced webs at the upper ends of the truss posts.

Floor System—A durable lightweight floor was used on the San Rafael bridge in what is believed to be the first installation on a highway suspension structure. The flooring, which consists of interlocking steel channels placed with the webs alternately up and down and covered with a mineral-surface asphalt plank, has a total weight (steel and asphalt) of 45 lb. per square foot of roadway area. Prefabricated units of eight channels, welded together in the shop and curved to the proper roadway crown, were furnished by the Belmont Iron Works, of Philadelphia, which also fabricated all the structural steel for the bridge; the Johns-Manville Co. provided the asphalt plank surfacing.

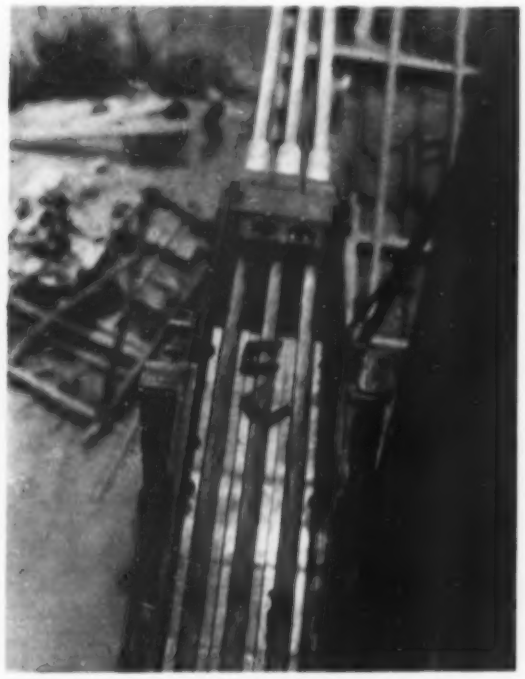
Channels of the flooring were laid at right angles to the stringers, to which they were plug-welded. The stringers are 15-in. 35-lb. sections spaced 5 ft. on centers and framed into 24-in. 70-lb. wide-flange floor beams riveted to the lower part of the vertical posts of the stiffening trusses. These trusses are a modified Warren type, with rectangular batten plates, instead of lacing, used to tie the channels forming the top and bottom chords. The panels are uniformly 14 ft. 11½ in. long.

After the steel-channel units had been welded in place on the bridge, the channel troughs were closed with asphalt fillers placed in asphalt cement. To the resulting smooth surface, a longitudinal flooring of mineral-surface asphalt plank was cemented, providing a non-skid, resilient roadway. Because of the stiffening effect of the transverse welded channels, it was possible to eliminate the conventional diagonal windbracing.

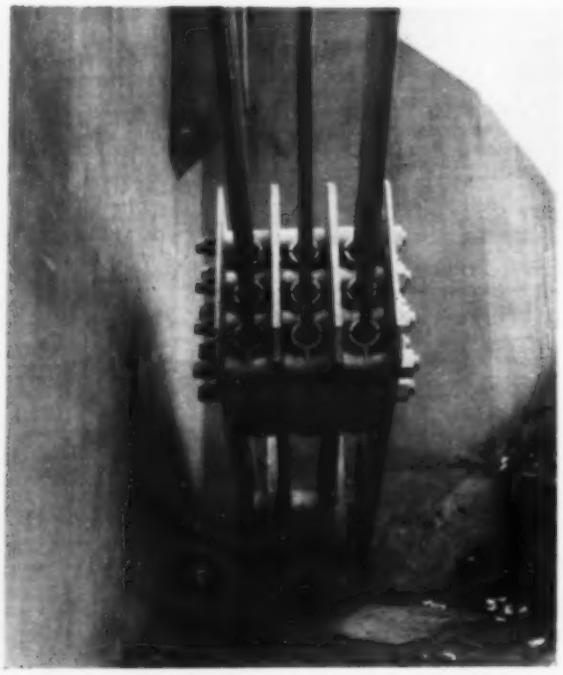
Labor Requirements — A provision of the contract with the San Dominican government required that native labor be employed, excepting one resident engineer from the Roebling staff under whose supervision the entire superstructure was erected. Bridgemen had to be drawn largely from among the local peasantry and had to be taught the intricacies of bridge building. Progress was slow during the early stages of erection, especially with the riveting gangs, but the eager workmen learned rapidly, and efficient foremen and gangs soon were developed, making it possible to complete the bridge in 10 weeks.

Erection Procedure — Simplicity marked the erection equipment, which consisted of a three-drum 30-hp. steam hoisting engine, a three-drum 15-hp. gasoline winch, a 40-ft. gin pole of 10-in.-diameter hard wood, a 63-ft. gin pole of 13-in. square yellow pine, a two-cylinder gasoline compressor, and a portable gasoline-electric welding machine, together with miscellaneous small tools and equipment. The 63-ft. gin pole first was set up on a pier to

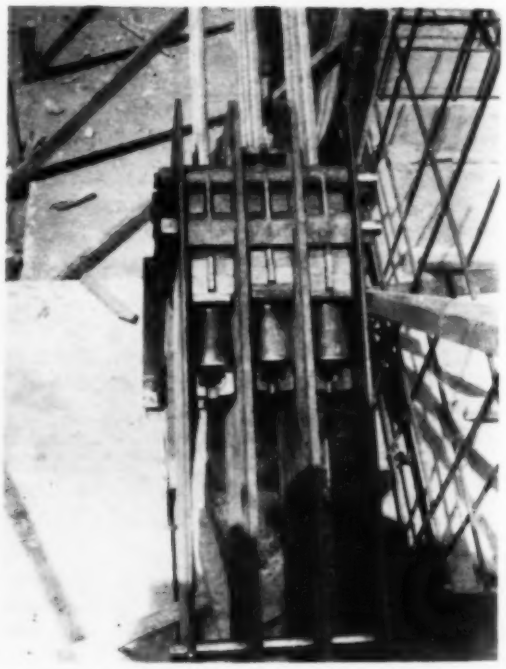
CABLE BAND, loosely bolted to strands at tower top, is ready to be hauled out to position on main cable. Native workers rapidly learn art of bridge building.



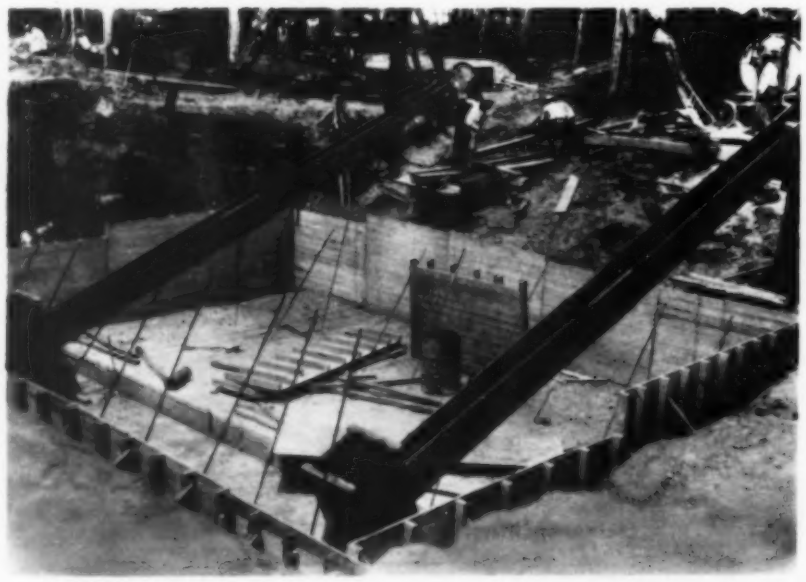
TOP LAYER OF STRANDS in tower saddle, as seen from above. Strands are supported on zinc filler blocks in saddle. Note zinc buttons on strands and shims used between buttons and bearing blocks to make adjustments.



CABLE TERMINAL of compact anchorage has bell-mouthed bearing blocks to provide proper support for strands where they emerge from anchorage and bend to splay point.



CABLE ANCHORAGE provides for field adjustment of strands by means of shims between fixed bearing blocks and bearing face of strand sockets. Bails on sockets facilitate adjustment by jacking.



FORMS IN PLACE for concrete pour at anchorage. Steel beams and anchorage bars will be buried in concrete of anchorage block resting on timber pile foundation.

TROUGHS of steel-channel deck are closed with asphalt fillers laid in mastic, forming level surface for plank flooring.

MINERAL-SURFACE ASPHALT PLANKS, laid longitudinally, form smooth, resilient top course of bridge roadway.

SUSPENDED STEEL advances from both towers to meet at midspan. No connections have been made in truss steel.

place the two lower column sections and the roadway portal strut and then was jumped to the top of the roadway portal to erect the rest of the tower steel.

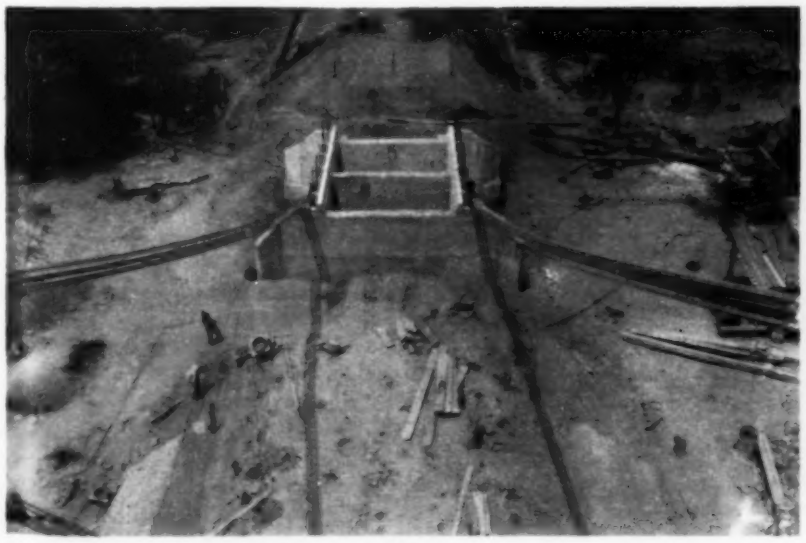
Strand reels were mounted near the anchorage, and an endless traction rope running around a return sheave at the opposite anchorage was used to pull the strand across the river, the outer strand socket being attached for this purpose to a pennant on the hauling rope. After the strand had been extended from anchorage to anchorage and the end sockets had been connected to the anchor fittings, whip lines were lowered from each tower, and the strand was hoisted and set in the saddle grooves. Strand adjustment was controlled by instrument from one tower leg.

Workmen had no difficulty in moving along the cable to positions on the main span, as the open cable provided a broad seat and the individual strands offered ready grips for the hands. Cable bands, hoisted to the tower tops, were clamped loosely to the cables and pulled out to their positions by manila tag lines. Suspenders were hoisted from the river and attached to the bands by the cable men.

Erection of truss and floor steel began at the towers and advanced simultaneously from them toward midspan. Light falls, attached to the main cables and moved by hand from panel point to panel point, served to swing the suspended steel into position. No top chord connections were made until all truss steel, floor beams, stringers, and one-half of the floor channels were in place. The chord connections then were loosely bolted but not riveted; and the chord was riveted only after the entire suspended dead load was in place.

Direction—The John A. Roebling's Sons Co. designed, supplied and erected the bridge under contract with the San Dominican government, for which A. W. Rogers is chief engineer. W. A. Reeve was resident engineer for the contractor, and Andrés Pastoriza acted as subcontractor for erection.

CONCRETE BOX (*below*) in front of cable anchorage will be filled with compacted sand. Box also will support approach roadway.



BACKSTAYS of bridge cables (*below*) rise from anchorage along sides of sand box placed in front of anchorage to give added stability.

NORRIS DAMSITE on Clinch River, Tennessee, showing rock-filled timber crib cofferdam, construction bridge, locations of quarry, cableway tracks, mixing plant and crest line of completed structure 250 ft. high.

Construction Plan Adopted for

NORRIS DAM

FAVORABLE conditions developed at the site of the $34,000,000 Norris dam of the Tennessee Valley Authority on the Clinch River in eastern Tennessee have permitted the adoption of construction methods and plant that will apparently enable this project to be completed in much less time than originally estimated. Although preliminaries were not begun until late last year, construction progress already is well ahead of schedule.. Present indications are that the dam may be completed by the end of 1935 and that storage of water may begin about that time.

Norris dam will be a gravity concrete structure, 250 ft. high, with a spillway built into it and a power house directly below it. This dam will create a reservoir having a maximum capacity of 3,600,000 acre-ft. and a superficial area of over 52,000 acres. This immense volume of storage will accomplish two purposes: Primarily, it will impound flood flows of the Clinch River so that water may be released during low stages in the Tennessee River below, on which a number of great hydro-electric plants have been and are to be built as a part of the TVA power program. This regulation of flood flows of the Clinch also will reduce the crest of most floods in the Tennessee and benefit navigation improvements in the latter stream.

Topography—Located in a broken, foothill country, the site of Norris dam is one of those rarely favorable locations for a great impounding reservoir. At one end of the damsite a hill rises abruptly from the edge of the water in the river to a height well above the crest of the dam. On the opposite side the slope is less steep, but is such that the dam crest length is only 1,800 ft.

Dolomitic limestone is practically at the surface at the site of the dam and over much of the reservoir area. Thorough exploration of this ledge rock proved it to be free from fissures or stratification that might cause loss of water under the dam or from the reservoir. On this satisfactory site the decision was made to build a gravity concrete dam. An overflow spillway will be built into the dam toward one end, occupying approximately the present stream channel. On the downstream toe back from the spillway guide wall will be a power house containing two 45,000-kw. water-wheel-generator units.

Materials—Original plans contemplated importing the sand and coarse aggregates required for the 1,000,000 yd. of concrete needed in carrying out the project. This would have called for a branch railroad about 6 mi. long to the site from main-line connections, involving a cost of about $750,000. Dependence on imported materials also would not have given the flexibility of operations desired, nor would such a plan have permitted the most satisfactory layout of construction equipment. Imported materials also would have cost much more.

On account of these conditions, thorough tests of concrete made from crushed stone and fine aggregate produced from the dolomitic limestone at the site were undertaken. These tests showed that excellent strengths could be obtained by using the local materials. Plans were accordingly made to install near the damsite a crushing and reducing plant that would produce the 750,000 yd. of crushed stone and the 350,000 yd. of sand needed for the job.

Elimination of the importation of the concrete aggregates reduced the amount of hauling to the site so much that it was possible to omit the branch railroad to the site. To facilitate delivery of cement and the large volume of other materials and supplies required, a heavy-duty concrete highway has been built from the main-line railroad to the site, as described in *Construction Methods* for March, 1934.

Plan of Construction—Conditions at the site of the dam and flood flows of record in the Clinch River do not indicate any specially difficult problems in handling work on the dam. The latter will be built in two sections. A rock-

COFFERDAM UNWATERED. Structure is of cellular timber-crib type filled with impervious material and closely sheeted on all exposed faces so that cofferdam may be overtopped during flood without serious loss.

filled timber-crib cofferdam has been built so the foundation of the first section, extending from midstream back to the left end of the dam, might be unwatered. While work on this section is under way, the stream will be carried in the remainder of the normal channel, which has been widened somewhat to give a carrying capacity of about 50,000 sec.-ft.

The greatest flood of record amounted to 60,000 sec.-ft. In case more than 50,000 sec.-ft. occur while the job is under way, the cofferdam is so built that it may be overtopped without important loss. All equipment has been selected so that it either may easily be run out of the coffer when high water threatens, or is of types that clear the maximum flood levels.

Cableways—Choice of the general method of building the dam narrowed down to either cableways or derricks. The cableway method was selected, for a number of reasons: In the first place, the quarry, the crushing plant and the mixing plant could be located to best advantage near the right-hand end of the dam. With cableways, it was possible to plan to handle concrete directly from the mixers to place in the dam in one operation. Use of derricks would have required either a double-track on a trestle across the site, or numerous shifts of concrete buckets from one derrick to the next. The cableways have complete flexibility and ability to serve all parts of the site at all times. Derricks in fixed positions would have lacked both these advantages.

Two 18-ton capacity cableways having a span of 1,950 ft. are being erected on traveling steel towers to serve the job. Both will have a travel upstream and downstream of 400 ft. The head towers will be on the right bank near the mixing plant. With this setup the entire site of the dam may be reached easily.

Mixers—Three 3-yd. mixers are being installed at a point about 150 ft. upstream from the axis of the dam and at an elevation above its crest. Concrete will be shifted from the mixers to within range of the cableways in 3-yd. tilting buckets on motor-driven transfer cars. The cableways will handle 6-yd. bottom-dump buckets which will be charged from the tilting buckets on the transfer cars.

There will be no need to unhook the cableway buckets either at the charging or the dumping points. They will be charged from the tilting buckets on the transfer cars quicker than hooking on and unhooking could be done. Danger to men handling hooking operations will thus be eliminated. The cableway operator also can speed up much more than he might if men were to be watched for constantly.

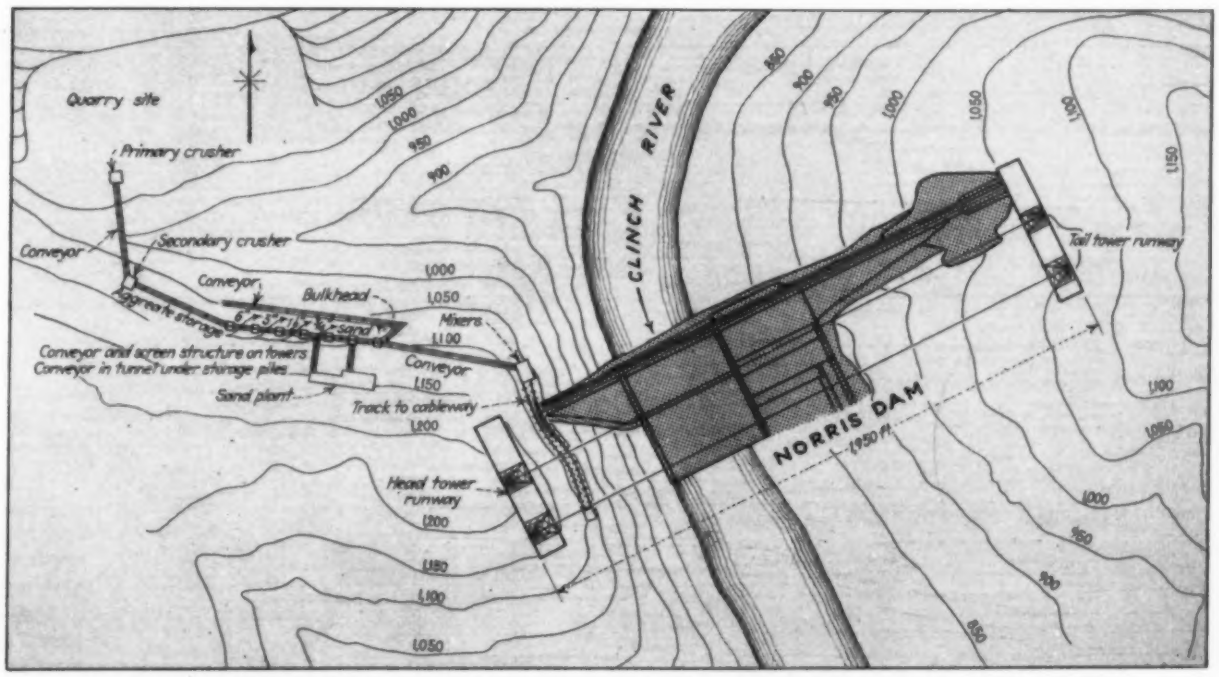
Plans for the equipment that will be used in quarrying, crushing, screening and storing the concrete aggregates have been worked out to permit continuous operation regardless of whether or not concreting is under way on the dam. Belt conveyors will be used in transporting the materials to and within the plant. Details of the latter will be described in a later article.

At the site of the dam comparatively little overburden and loose rock needs to be moved. This excavation is being handled by power shovels loading motor trucks carrying 8-yd. dump bodies. The spoil has been used in filling the cofferdam and in bringing the remainder of the site to the required levels. No long hauls are involved.

Labor—All labor on the project has been recruited from the Tennessee Valley, the unskilled men coming largely from the vicinity. TVA used great care in selecting men who were physically fit. All skilled men had to have experience on similar jobs. Due to the standards set up and to the native ability of the local people, an exceptionally efficient organization has been obtained.

Four shifts of men, each working 5½ hr., are employed 6 days a week. Each 24 hr. the 2-hr. interval is arranged to come in the middle of the day. Equipment maintenance and minor repairs may thus be best handled.

A. E. Morgan, chairman of the Tennessee Valley Authority, personally has charge of all construction operations. C. H. Locher is construction consultant on all TVA undertakings. Barton M. Jones is engineer in charge of construction and Ross White is superintendent of construction on Norris Dam.



CONSTRUCTION PLANT LAYOUT, showing location of cableways, quarry, crusher plant and conveyors and concrete mixing plant.

Concrete Piles for Erie Railroad Viaduct

DRIVEN 3 DAYS AFTER CASTING

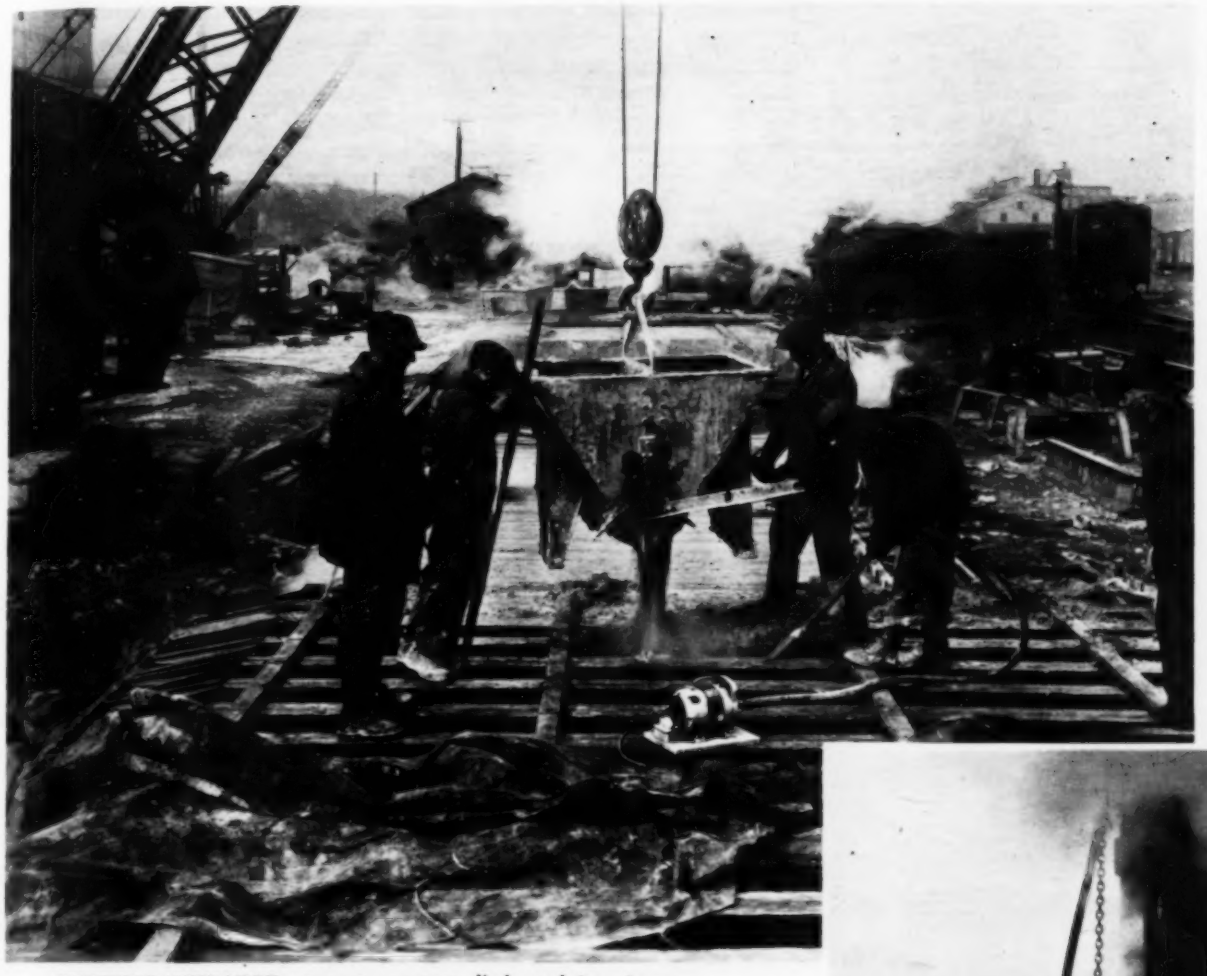
FORMS FOR PILES *(below)* with steel reinforcement in place, ready to receive concrete.

SECOND TIER of piles *(below)* is cast by setting forms on top of lower tier.

AT ELMIRA, N. Y., the Folwell Engineering Co. has had a crew of 20 men at work this winter fabricating concrete piles for a viaduct to carry the main-line tracks of the Erie Railroad over several of that city's principal streets. Piles are 18 in. square with beveled corners and are being made in two lengths, 18 and 25 ft. Regardless of low temperatures, of which Elmira has had an ample share, the average daily output has been 30 piles, rainy days excepted. On several nights during December the thermometer dropped well below zero.

There is nothing especially interesting in a crew of 20 men casting two and a half dozen piles a day—even at freezing temperatures. This is said to be no better than a normal record for that many men with good equipment, and certainly concrete piles have been cast many times previously during cold weather. But these particular piles are driven into hard soil with a 5,000-lb. hammer when only 3 days old. This unusually short interval between fabricating and driving piles has been made possible by the use of Incor high-early-strength cement. Because the piles could be safely driven in so short a time after casting the contractor was enabled to start pouring pier foundations fully two months ahead of a schedule based on the use of ordinary portland cement, since the railroad's specifications require for piles made with ordinary cement a lapse of more than 60 days before driving. As an employment measure the pouring of the pier foundations two months in advance meant increasing the working force that much ahead of time from

HOPPER BOTTOM BUCKETS containing concrete are delivered by motor truck, raised by crane and discharged into forms.



ELECTRIC VIBRATOR compacts concrete discharged into forms from hopper-bottom bucket.

100 to 250 men. This was a big boon to the community where a number of men had been on relief lists for more than three years. It means, too, a cut of at least 10 per cent in the contractor's overhead and the advantages to the railroad and the public of an earlier use of the completed structure.

Casting Piles—Piles are poured in sets of 10; three sets are considered a fair day's run. As soon as the first set is poured heavy tar paper is carefully laid over the top, the ends and sides are protected with burlap and straw and the whole covered with a tarpaulin, when steam is injected for curing. The next morning the tarpaulin is removed to make way for the locking up of forms and placing of reinforcing for the second tier of piles. During these operations and the subsequent pouring steam continues to be injected into the first tier. After the second tier is poured, it and the first tier again are covered with the tarpaulin and steamed continuously for48 hr. Twenty-four hours later forms are stripped from the piles of both tiers. Piles are then removed either to the stock pile or direct to the place of driving.

Piles are cast in only two tiers to allow the men to work close to the ground. Wooden forms are used except for the points, which are steel. Points are 2 ft. long and have a 5-in. tip. Reinforcing consists of a No. 6 gage spiral with 6-in. pitch and eight longitudinal ½-in. round rods.

Concrete for the piles is mixed in a separate small mixer housed in the contractor's regular concrete plant. This plant is but a couple of hundred feet distant from where piles are fabricated. A typical 1-yd. batch contains: Cement, 6 sacks; sand, 1,350 lb.; stone, 2,300 lb.; and water, 29 gal. This is equivalent to 1:2.3:3.8 mix, giving a concrete of satisfactory consistency for the purpose. Concrete is delivered in a side-dump hopper mounted on a platform truck. From the hopper concrete is discharged, in half batches, into a bottom-dump bucket resting on ground, which is handled by crane to the forms. Concrete is spaded as it goes into forms and then vibrated with a mechanical vibrator.

Steam Curing—Because of a steam curing requirement of only 48 hr. and the ability to strip forms and handle piles at that age or shortly thereafter, using high-early-strength cement, it was found necessary to make up forms for only 180 piles on this work. Ordinarily, the contractor estimates, he would have to make up forms for double that many piles. Thus he is effecting not only a saving in forms and curing, but is conserving considerable space, which is also important in view of the congested area in which the work is being executed. To wait 60 days after fabricating piles before driving, and producing at the same rate of 30 piles a day, a total of 1,500 would be accumulated before a single pile could be driven. This would necessitate storage areas in various parts of the city, which would result in heavy additional expense, especially for hauling. Under the present procedure not more than 60 or 75 piles need be held in storage, with an additional 100 being cured or cast.

Driving Piles—One piledriving outfit is used on the job. This is equipped with a No. 1 Vulcan single-acting hammer, weighing 5,000 lb. and having a drop of 3 ft. The piles are driven to a final penetration of 1/20 in. per blow. Despite this rigorous specification breakage has been insignificant, nor have butts shown any signs of spalling or other damage.

There are from 23 to 45 piles to a pier. They are driven in clusters and spaced on 3 ft. 6 in. centers. The driving crew consists of 9 men; this crew drives an average of 30 piles per day, when weather permits. There is a total of about 40,000 lin. ft. of piling in the job, and the driving is being done on a

DRIVING was done with a 5,000-lb. hammer after the piles were only 3 days old. Piles are 18 to 25 ft. long and 18 in. square with beveled corners.

subcontract basis by E. A. Whitney & Sons, Inc., of Kansas City. The strength requirement for driving is 3,500 lb. per square inch.

The quantity of concrete in the Folwell contract, exclusive of piles, is approximately 25,000 cu.yd. The work involves the erection of a 1,700-ft. elevated track structure, and one approach, 2,400 ft. long, confined by retaining walls. (The original grade is intersected in an additional 600 ft.)

The viaduct extends westward from the double-track Erie Railroad bridge over the Chemung River and will separate six street crossings in Elmira. The Elmira station is located one block west from the west end of viaduct. Traffic on all six streets is subject to serious delays due to the frequent and slow train movements in the area. The movements are slow because of the proximity of the bridge crossing and the station. Many of the trains are long freights. Consequently the separation of these crossings will be of inestimable benefit to the city.

The viaduct will be of reinforced concrete, except for street spans, where steel beams encased in concrete will be used. The street spans range from 22 to 48 ft. The structure will accommodate three tracks for the first four blocks west of the Chemung River and two tracks for the remaining two blocks.

Concrete spans are 18 ft. The two-track section has two-column bents, and the three-track section three-column bents, with columns on 16- and 14.5-ft. centers, respectively.

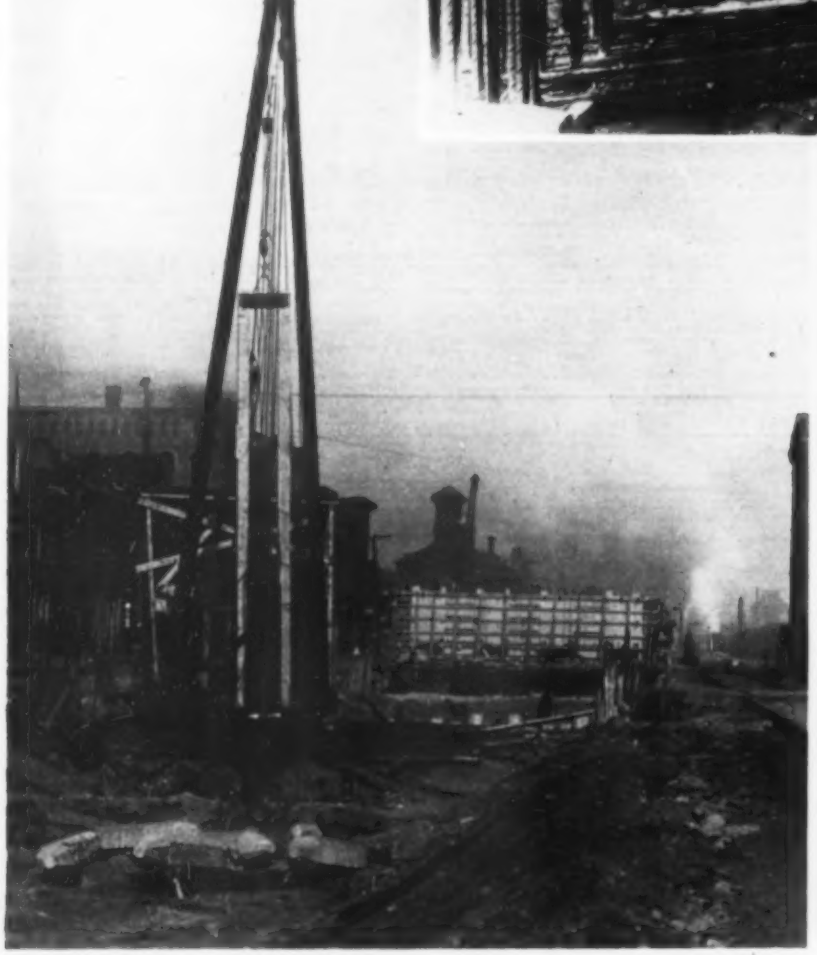
Winter Work—The contractor made thorough preparations for carrying on the work during winter. Mixing water and aggregates for concrete are heated by steam, enabling concrete to be placed in the forms at a temperature of from 70 to 75 deg. F. The fresh concrete is then covered with a tarpaulin and steam is injected until all danger from freezing has passed.

This job is one of three sections, totalling about 5 mi. long, upon which the Erie Railroad has been doing preliminary work for the past couple of years. Approximately 2 mi. of the general project extends eastward from the Chemung River. This section, for the greater portion of its length, forms the eastern approach to the structure just described. The general project also includes the raising of the Chemung River bridge about 18 ft. above its original level. Part of this feat has already been accomplished, the railroad doing this work itself. The bridge's span is 700 ft.

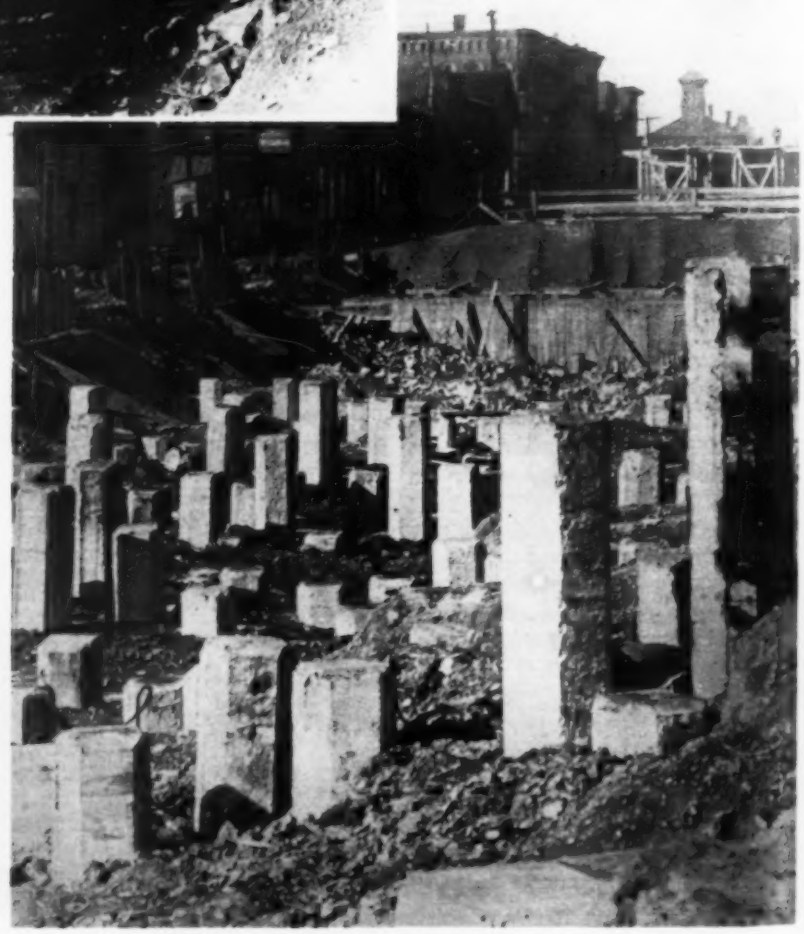
East of the Chemung River the work consists of a fill confined by retaining walls for a distance of about one mile, an unconfined fill for another mile, and the revision of a 9-track yard. Involved in this work are about 15,000 cu.yd. of concrete, for the placing of which the Metzer Co. of Buffalo has the contract. On this side of the river also, intersecting streets are being separated. Five streets are involved. The first two streets to the east of the bridge will cross under the tracks at their original elevations, while the other streets will be depressed to varying degrees.

The State of New York is participating in this grade crossing elimination work to the extent of 50 per cent of the cost. The structures were designed by and the work is being executed under the direction of the Engineering Department of the Erie Railroad for which C. M. Burgess is resident engineer.

SUBSTRUCTURE *(below)* on pile foundations has reinforcement extended to tie in with columns supporting viaduct.



CLOSE BEHIND PILEDRIVER forms are set up to receive concrete for piers of elevated track structure.



CLUSTERS of from 23 to 45 piles are driven to support piers of railroad viaduct structure.

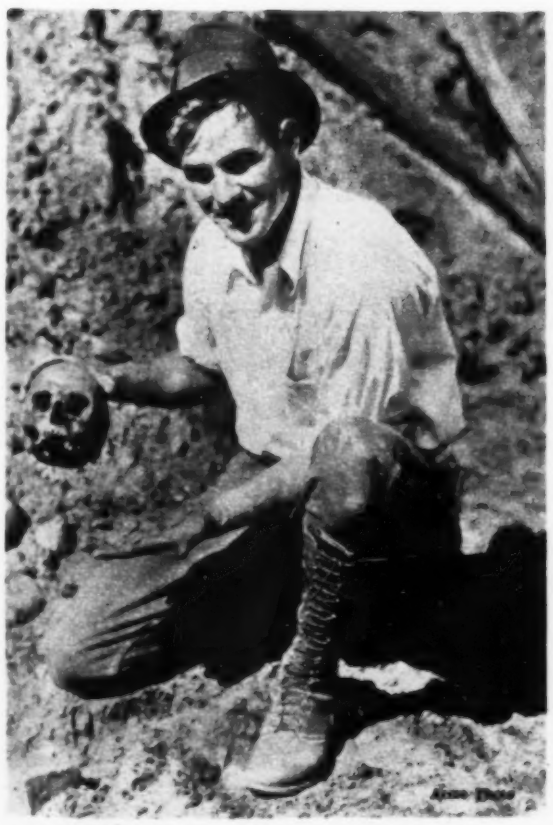
JOB ODDITIES

A Monthly Page of
Unusual Features of Construction

ATTIC GARAGE. Reversal of usual basement location for motor car storage is necessitated by side-hill construction of house at Sausalito, Calif., with road almost at roof level.

ROCK OF AGES. Easter cross of concrete, 103 ft. high, is erected on top of Mt. Davidson, overlooking San Francisco Bay. Corner stone in base of structure, dedicated last month, contains water from River Jordan and rock from Garden of Gethsemane.

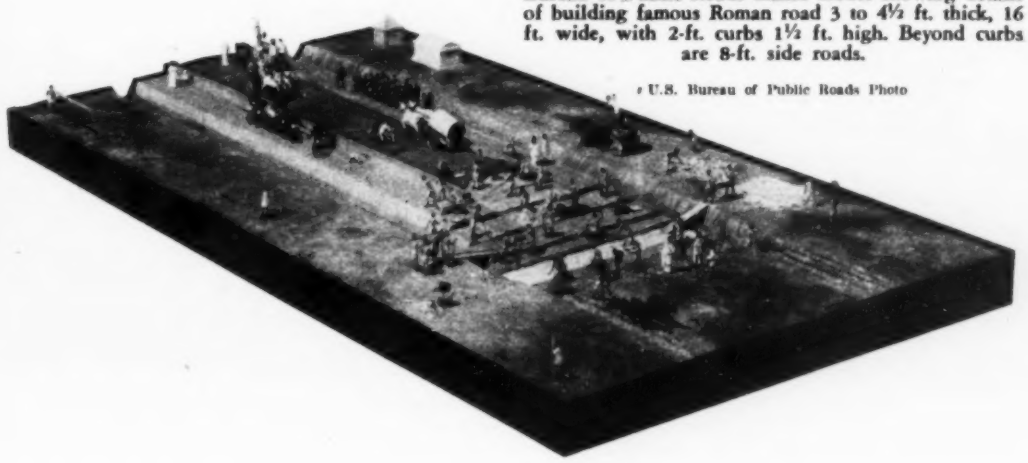
HEATED TENT protects concrete bridge on forest highway near Flagstaff, Ariz., during winter construction under supervision of U. S. Bureau of Public Roads.



UNEARTHED BY CWA WORKMEN. During excavation for foundations of new Federal building in San Francisco skull and gold coins are uncovered by Herbert C. Ball, civil engineer on the job.

CONSTRUCTING APPIAN WAY. (*Below*) U. S. Bureau of Public Roads makes model showing details of building famous Roman road 3 to 4½ ft. thick, 16 ft. wide, with 2-ft. curbs 1½ ft. high. Beyond curbs are 8-ft. side roads.

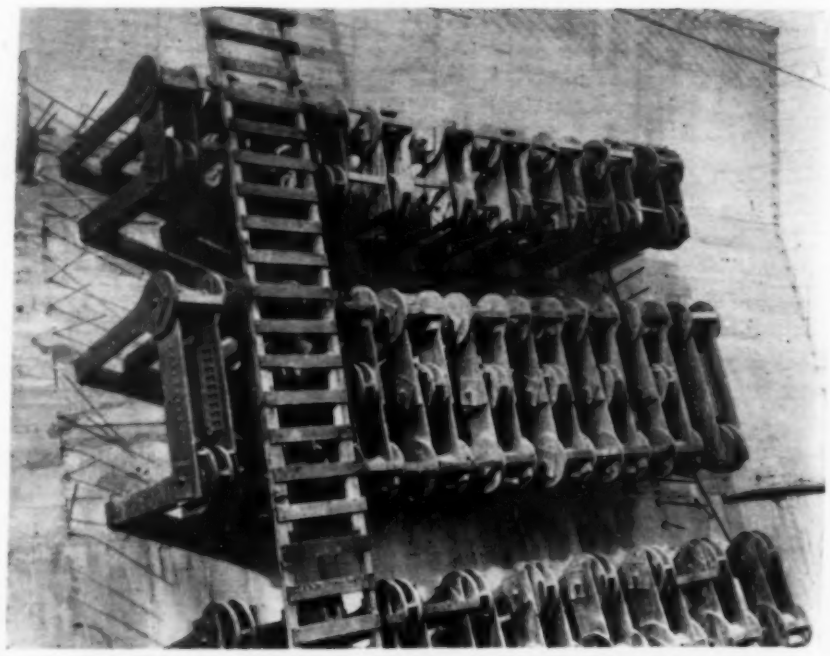
U.S. Bureau of Public Roads Photo



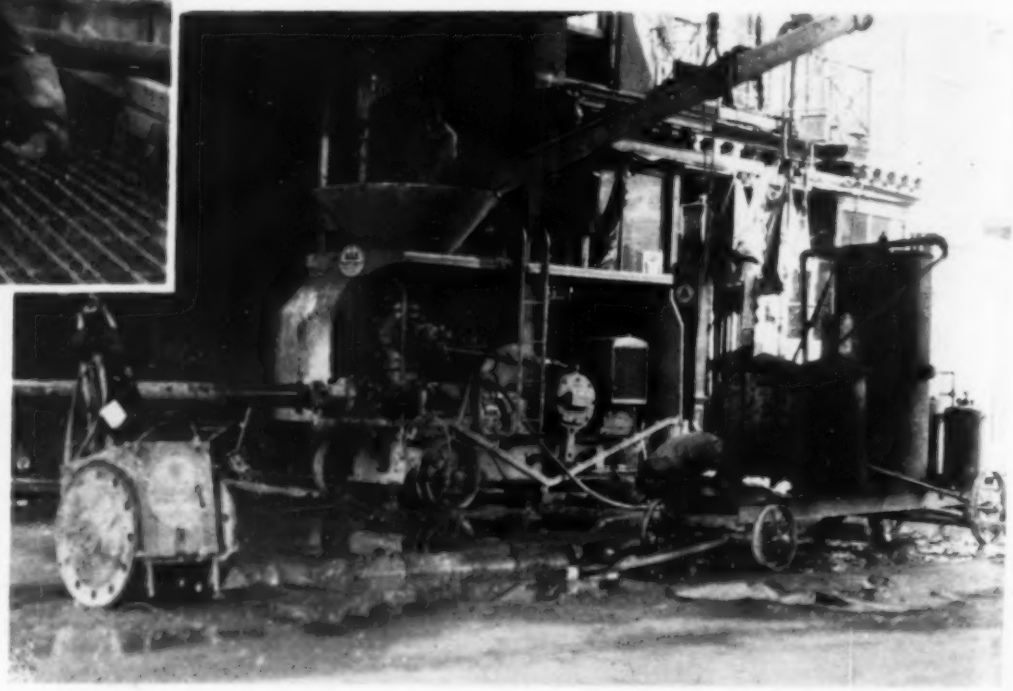
Getting Down to

DETAILS

[Close-up Shots of Job Methods and Equipment]



GOLDEN GATE BRIDGE ANCHORAGE. Ends of 36½-in. diameter cables supporting 4,200-ft. clear suspension span (world's longest), at San Francisco, will be held by steel eyebars embedded in twin three-tier gravity-type anchor blocks of concrete, each weighing 64,000 tons. Pull on each cable at its anchorage will be 63,000,000 lb., or a total of 126,000,000 lb. for each anchorage. Contract for the cable anchorages and piers for the approach spans of the bridge, amounting to $1,189,000, is being executed by Barrett & Hilp, of San Francisco, for the Golden Gate Bridge and Highway District, Joseph B. Strauss, chief engineer.

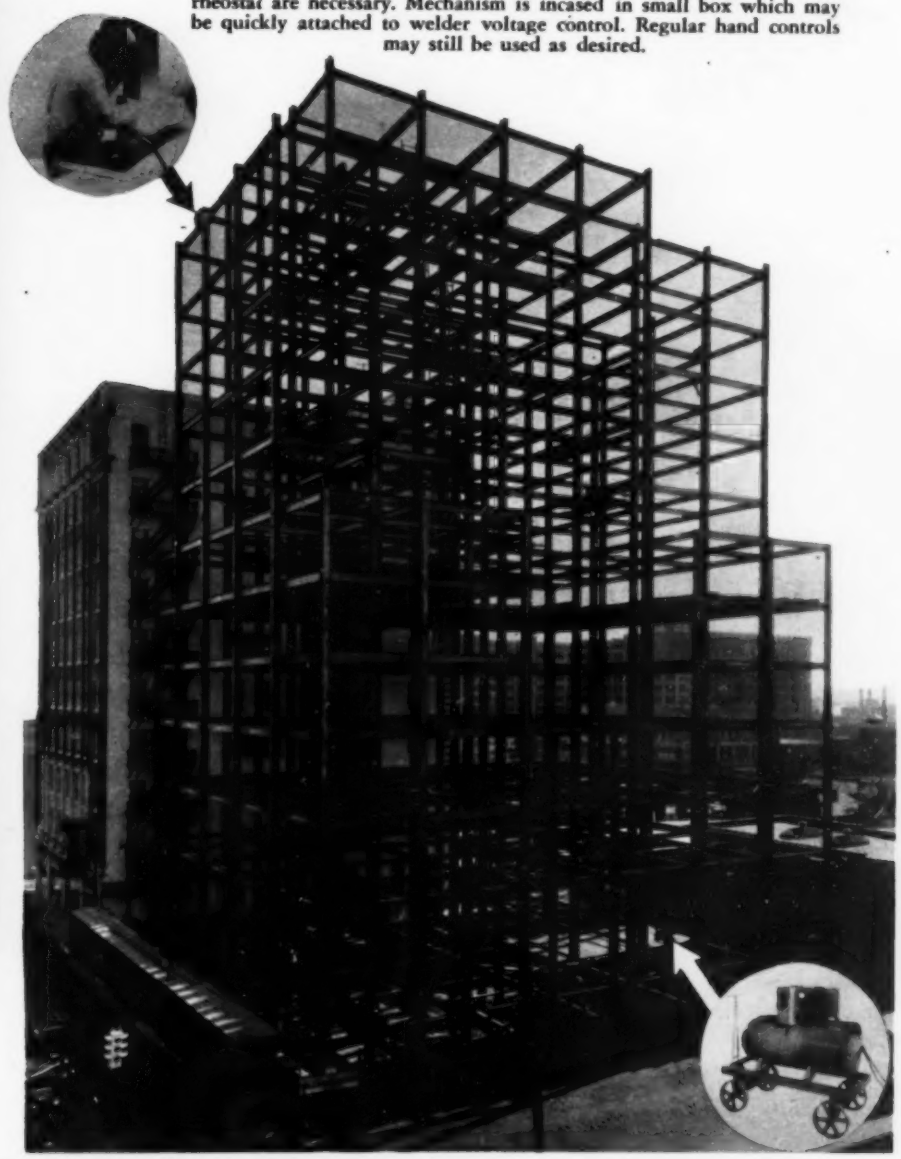


CONCRETE PUMP (*right*) set up at intersecting streets delivers concrete to points on deck of elevated railroad viaduct (*above*) which are inaccessible to tower paver outfit. Single-chamber Rex Pumpcrete unit forces concrete 21 ft. vertically plus 350 ft. horizontally for Corbetta Concrete Corp., subcontractor on 18th St. viaduct, part of New York Central R. R.'s track elevation program on west side of New York City. Pump handles concrete mixtures with slump of 3 in. or greater and apparently operates with maximum efficiency when delivering concrete of about 4-in. slump. Pistons and cylinders of pump used on this job have renewable linings. Continuous pumping action delivers steady flow of concrete to forms. Pipe line is made up of 10-ft. sections, 6 in. in diameter, connected by quick-acting toggle-type couplings.

MOVABLE CHUTE, mounted on wheels, is devised by Morse Brothers Construction Co., of East St. Louis, Ill., to facilitate the unloading and placing of wet batches of concrete, delivered by truck, on pavement widening and resurfacing project in Madison County, Ill. Use of chute allows end-dump concrete to operate along line of forms, without turning or backing up.—*Photo from* ERNST LIEBERMAN, *chief, Illinois Division of Highways.*

"ELEPHANT TRUNK" of flexible-joint pipe sections, attached to bottom of receiving hopper suspended by chains from cableway bucket, enables W. E. Callahan Construction Co., of St. Louis, Mo., and Peterson, Shirley & Gunther, of Omaha, Neb., to deposit concrete behind forms for lining rock walls at Madden dam, Canal Zone. Concrete for main body of dam is delivered by special cylindrical 8-cu. yd. bucket, illustrated in *Construction Methods* for March, 1933, p. 20.

REMOTE CONTROL FOR ARC-WELDING (*below*) allows operator to work at any desired distance from machine and regulate current accurately without making trips back and forth to adjust controls. With device known as "Lincontrol," developed by Lincoln Electric Co., current output of generator is regulated by tapping electrode on work to make and break electric circuit. No additional cables or rheostat are necessary. Mechanism is incased in small box which may be quickly attached to welder voltage control. Regular hand controls may still be used as desired.



BIG BUGGY FOR MOVING MATERIALS. For handling 227,000 cu. yd. of rock fill in connection with approach to San Francisco-Oakland Bay bridge, Frederickson & Watson, contractors, of Oakland, Cal., are using three Le Tourneau tractor-hauled buggies of new design and exceptional carrying capacity. Each buggy (*left*) has a 25-cu. yd. all-welded steel body mounted on eight 46-in. wheels equipped with Goodyear airplane-type 20-in. pneumatic tires, carrying air at 40-lb. pressure. Body dimensions are 10 ft. wide, 12 ft. long and 4 ft. deep. Bodies are made of special alloy steel, weigh 16,000 lb. and will carry loads of 40 tons. Dumping (*above*) is done by sliding body along wagon bed by cable operated from tractor.

ORDINARY FRUIT SPRAYER is used by Lund & Sager, contractors, to oil steel road forms on concrete paving contract for Illinois Division of Highways near Murphysboro.

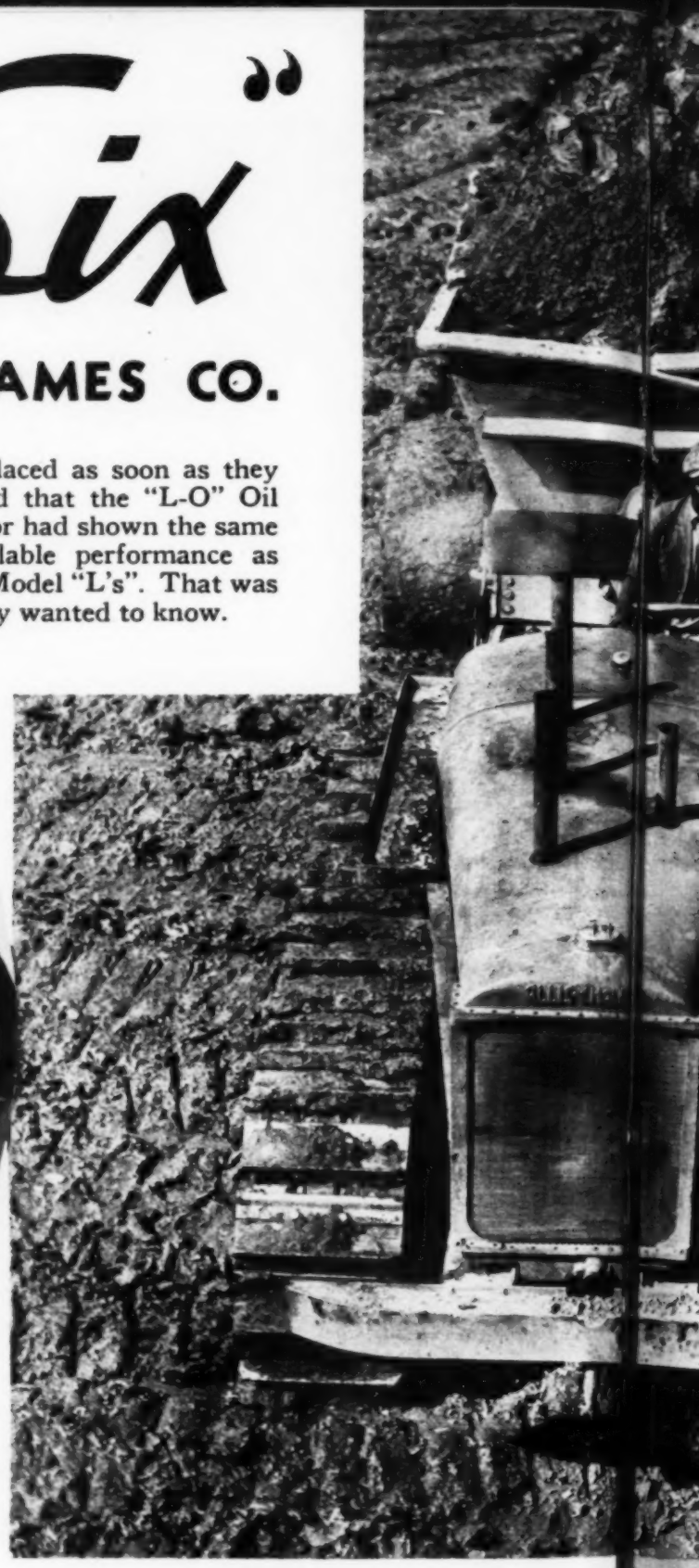
"Send us Six"

SAYS THE ORDER OF FORCUM JAMES CO.

. . . placed as soon as they learned that the "L-O" Oil Tractor had shown the same dependable performance as their Model "L's". That was all they wanted to know.

"I Want Four 'L-O's'"

said Mr. Walter Denison as he signed the order. "I've used all makes but the tractors I want for my jobs have to equal my 'L's' and these 'L-O's' surely do, plus lower fuel cost."



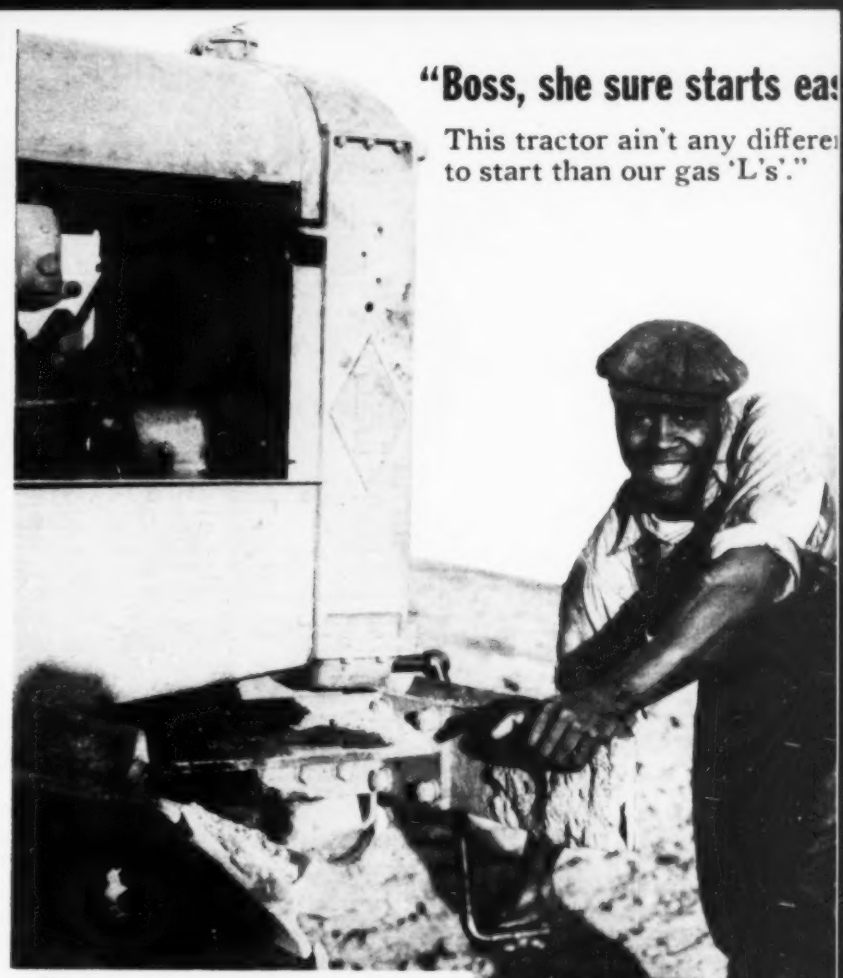
An "L-O" pulling a 12 yard wagon on Forcum James' levee job near Memphis, Tennessee.

"That's the Tractor for Me"

said Mr. Blair Lowrance. "Your 'L-O' has the simplicity, easy starting, right weight and low fuel cost I have been looking for. Send me two now."

The Talk of the Construction Industry

The acceptance by contractors of the new Allis-Chalmers Oil Engine Models "K-O" and "L-O" is plainly shown by the advance orders that have been placed. Within one week after the announcement there were 35 units ordered by levee contractors alone. We suggest your early investigation of these new fuel oil burning tractors so that you may be protected on early delivery.



"Boss, she sure starts eas

This tractor ain't any differe
to start than our gas 'L's'."

Controlled Alignment

One of the most important developments in tractor history. The exclusive stabilizer cranks used in A-C tractors have successfully solved the problem of keeping tracks in proper alignment and providing free oscillation.

A-C Again Sets the Pace

In announcing the A-C Oil Tra
tors we introduced an entire
new successful principle in tra
tor engines. We use a Diesel fu
pump to inject the cold char
into cold air and ignite it with
spark. We do not depend up
compression for ignition, but u
the time tried magneto . . . Th
engine operates with less ma
tenance cost because the inter
pressures are less than one-th
those used in the compressi
type. With confidence we of
this engine, knowing that it w
do more work at less cost th
any other tractor engine.

ALLIS-CHALMERS
TRACTOR DIVISION · MILWAUKEE, U. S. A.

SPILLWAYS

For Boulder Dam Are Deep Cuts in Rock, Concrete-Lined

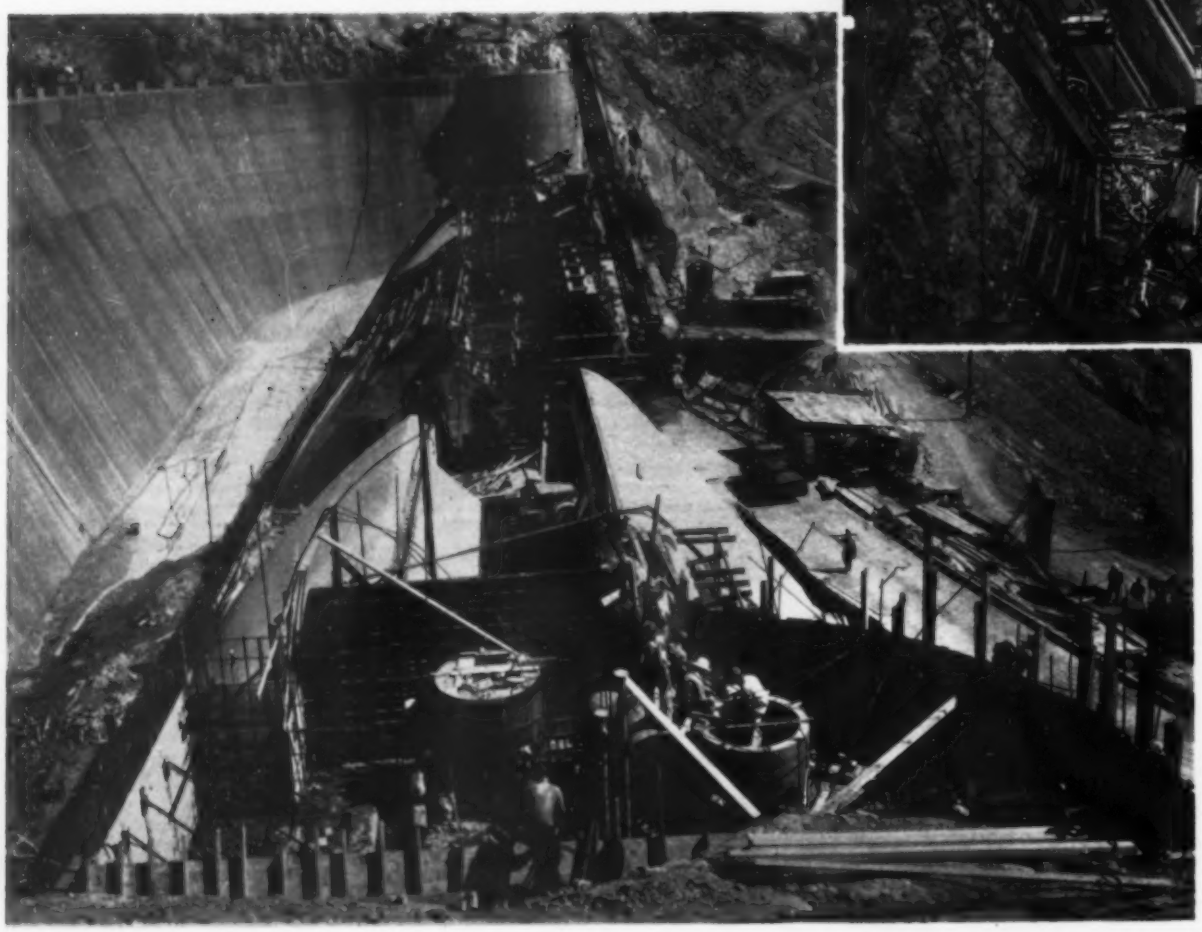
TWO GIGANTIC MAN-MADE GORGES cut out of solid rock form the spillways built to handle the flood flow of the Colorado River at Boulder Dam. Each side-channel spillway has an over-all length of about 700 ft., a maximum depth of 128 ft. opposite the lower end of the crest and is designed to handle 200,000 sec.-ft. of flow, with regulation provided by four 100x16-ft. steel drum gates. About 700,000 cu.yd. of solid rock excavation was required to provide the two cuts and the weir sections; lining required almost 150,000 cu.yd. of concrete for the two spillways. The spillways have been built by Six Companies Inc., as part of the general Boulder Dam contract.

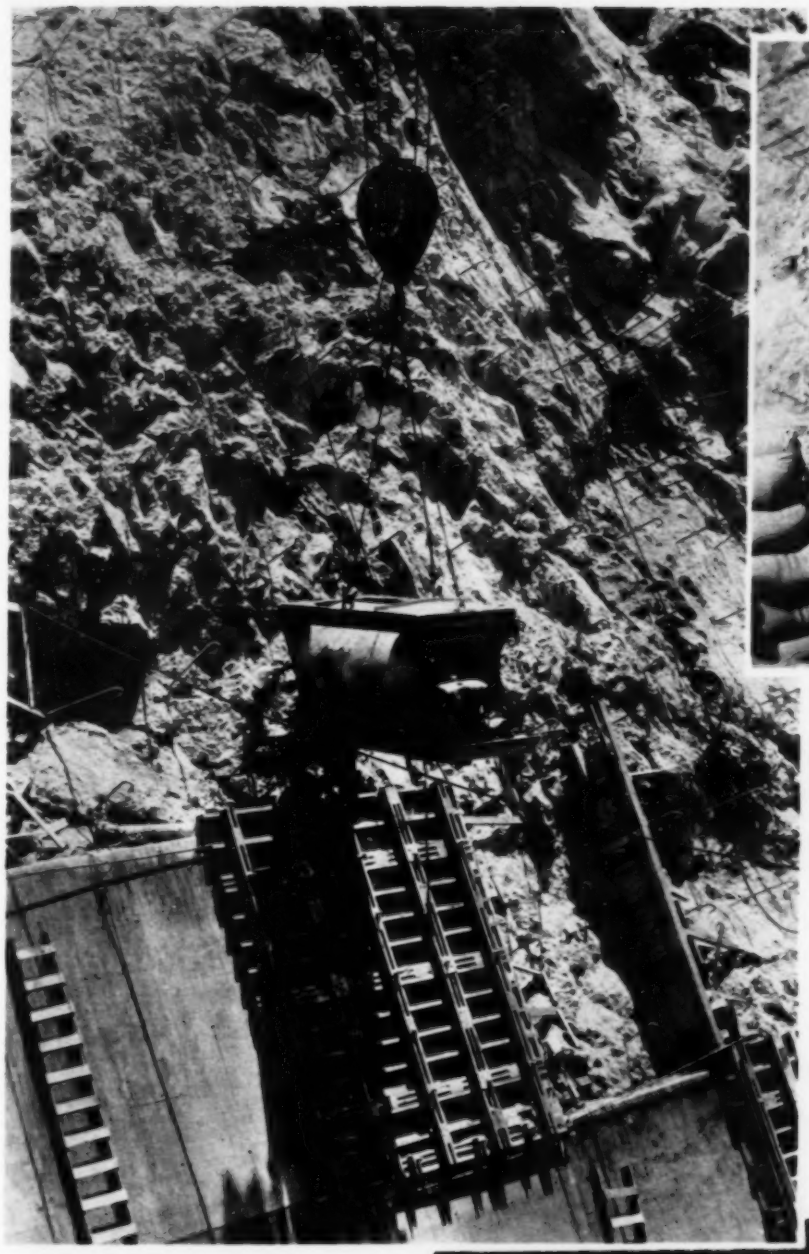
Location and Operation—Topography at the damsite indicated that side-channel spillways presented the only feasible means of handling the exceptional flood flows of the Colorado. Each of the two spillways provided is located several hundred feet back from the canyon rim. Except for reversal of features because of the position on opposite sides of the canyon, they are identical units. Each spillway discharges into the outside diversion tunnel which will be used for permanent spillway flow following the construction period. The spillways are connected to the tunnels by means of inclined tunnels 50 ft. in diameter.

The fixed lip of both spillways is at Elev. 1,205 or 27 ft. below the crest of the dam, at Elev. 1,232. Each spillway crest is provided with four steel drum gates, each 100 ft. long, which operate automatically to maintain the surface of the reservoir about 16 ft. above the weir crest at Elev. 1,221. Each of these gates is a closed structural steel vessel which fits into a recess in the weir sections. An automatic control mechanism provides that when the level of the reservoir reaches a set elevation the water enters the recesses and the gates begin to float. They continue to rise to their maximum height and then, if the flood flow continues to increase, the mechanism provides for their gradual lowering until at maximum flood discharge they are again in the lowest position in the recesses. Up-

LINING ROCK CUT with concrete at spillway on Nevada side of Colorado River. Channel 700 ft. long and 128 ft. deep will pass 200,000 sec.-ft. of flood flow.

WEIR CREST *(below)* of Nevada spillway, showing detail of pier construction for one of four steel drum gates, each 100 ft. long, which will maintain reservoir level automatically 16 ft. above crest.





AGITATOR TRUCK BODY, suspended from cableway, deposits concrete behind forms for 24-in. thick lining on back wall of spillway cut.

GROUT MACHINE, on truck mounting, is used on operation of anchoring 1⅛-in. square dowel bars in rock to support 14x15-ft. form panels.

on the reduction of flood discharge they again gradually assume their raised position to maintain the maximum storage in the reservoir. The total capacity of the two spillways is 400,000 sec.-ft. (50 per cent higher than the greatest flood of record) and in addition to this capacity there is the effect of 9,500,000 acre-ft. of the reservoir reserved for flood control as well as the 120,000-sec.-ft. capacity of the power house and outlet valves.

Excavation—Drilling for the 700,000 yd. of solid rock excavation was done principally with jackhammers drilling down-holes. The blasted rock was loaded by the same Marion electric shovels which had been used in handling the diversion tunnel muck. The rock was all moved by trucks to the point of disposal.

The finding of space sufficient for the wasting of this large volume of rock presented a difficult problem in the available area. Construction roads with hairpin turns and steep grades were required. On the Nevada side the material was all wasted in nearby side canyons and on the Arizona side a large volume of the excavation was used for constructing fills to provide runways for the traveling towers of the cableway system. Although the volume of rock moved made the excavation a large size undertaking, no particularly unusual construction operations were involved.

Weirs—On the canyon side of each spillway is the overflow weir section which, because of its size, has all the design and construction features of a regulation gravity dam. With an overflow profile, the dam on the Nevada side had a maximum height of 75 ft. and the corresponding height at the Arizona spillway was 85 ft. Construction of these weirs, including form work, placing of concrete, construction joints, grouting, etc. was practically identical with the work carried on in the main dam. An exception was the fact that the concrete was mixed at the

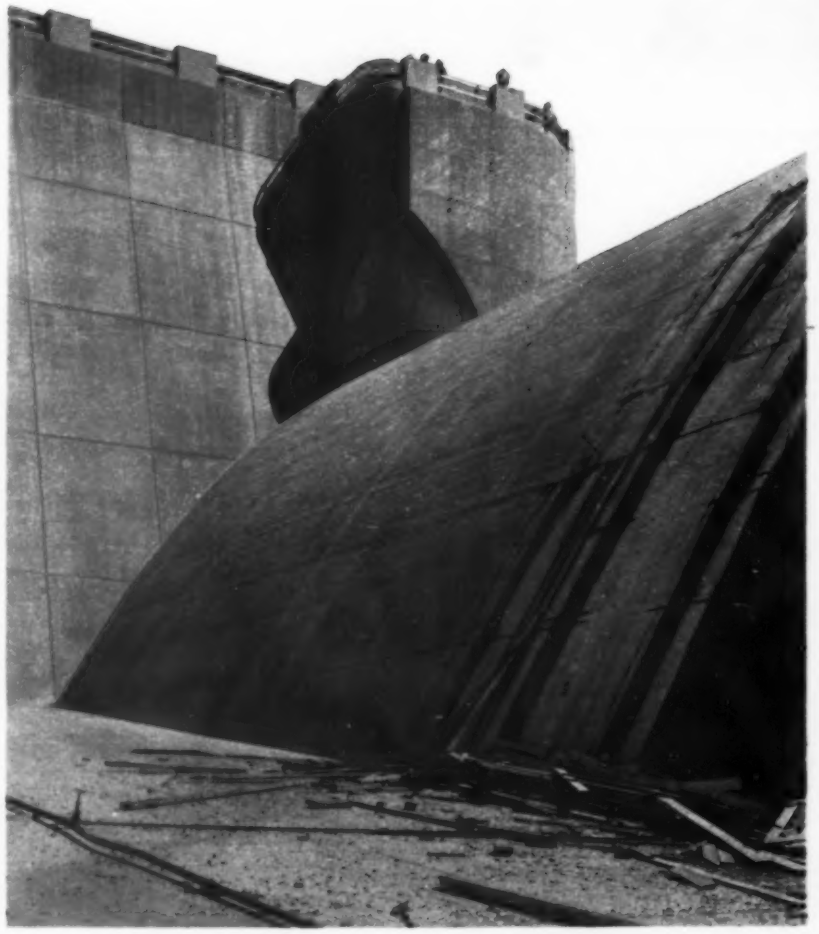
ARIZONA SPILLWAY *(right)* looking at outside of weir and across channel toward back wall which is built up as slab and buttress dam instead of concrete-lined rock.

high-level plant and moved by trucks with agitator bodies either directly to the Nevada spillway or by transfer on cableway to the Arizona side. This concrete was then either transferred to 2-yd. buckets handled by derricks or deposited directly from the 4-yd. agitator bodies. The type of concrete work in these weir sections is shown in several of the accompanying illustrations.

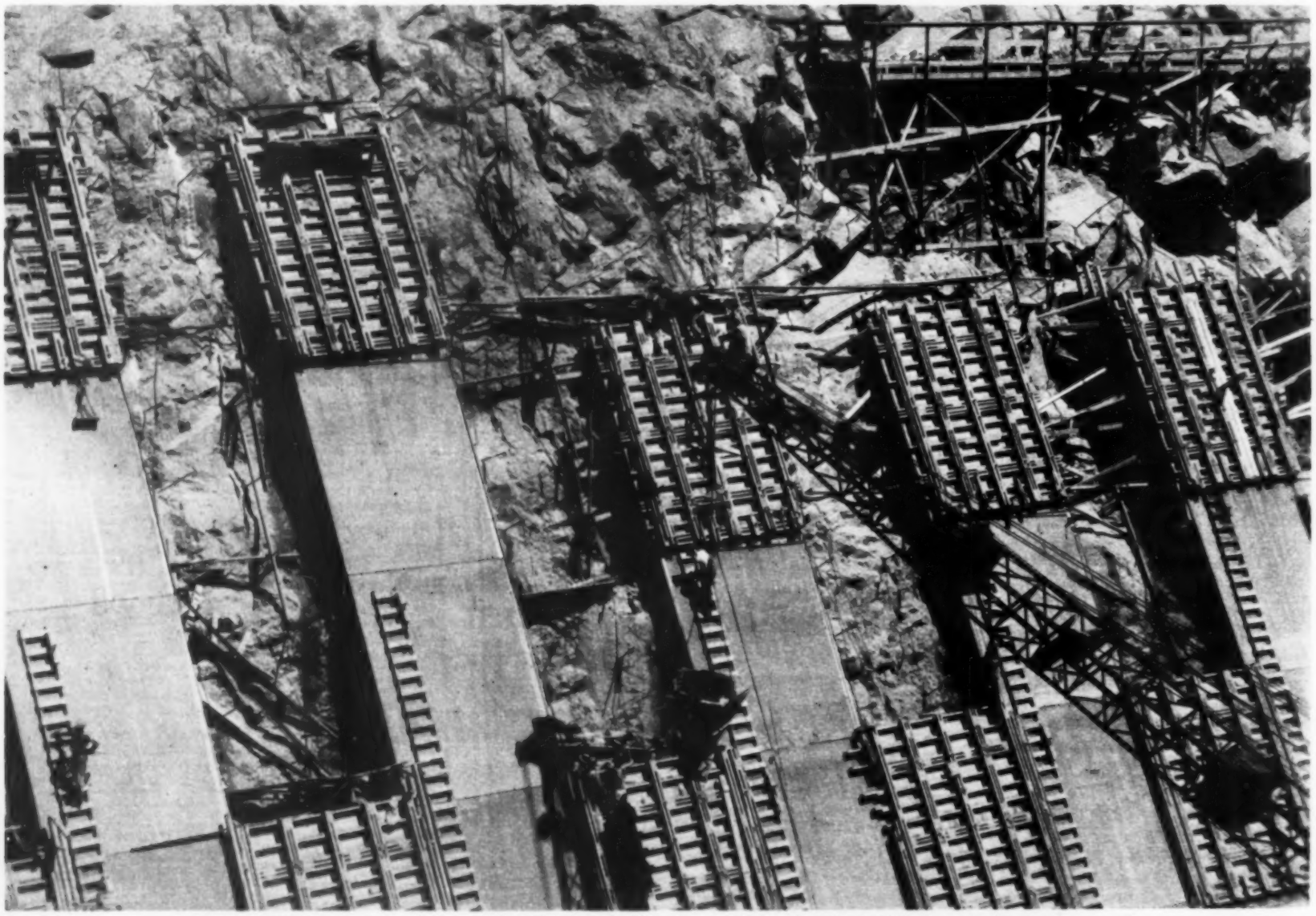
Lining—The sides and bottom of both spillway channels and the transition section leading into the inclined tunnel are lined with a 24-in. thickness of concrete. This lining thickness is increased in the shaft to 36 in. which corresponds with that in the diversion tunnel. Nominal reinforcing was provided in the channel lining. The lining on the walls of the channel was constructed in 14x15-ft. panels and these individual concrete slabs are secured to the rock wall by hooked 1⅛-in. square bars grouted into holes drilled at least 5 ft. into the rock. These anchor bars secured the lining to the rock and at the same time assisted in the placing of reinforcing steel before concreting. The contractor used a separate system of dowels for holding the panel forms in position.

An extensive system of drains was installed behind the lining, necessitated by the high head and the volume of water involved. Behind each of the vertical construction joints in the wall lining are lines of porous concrete tile 6 in. square with a 3-in. hole in the center. These lines of drains extend down behind the joints to the bottom of the wall, across the floor to a 2½x5-ft. manway extending under the center line of the channel floor. As an additional drainage provision, the entire bottom of the channel, which is concrete paved, is underlaid with a 12-in. thickness of the same porous concrete. The drainage from this system extends into a tunnel in the canyon wall where it intercepts the drainage collected in the weir and finally discharges into the inclined tunnel.

This description of design and construction applies equally to both the Nevada and the Arizona spillways with one exception. The topography on the Arizona side of the canyon did not permit the backside of the spillway to fit directly against a solid rock back wall. As a result, it was necessary to support the backside of the channel with reinforced concrete (making this wall conform to the design of a slab and buttress type of dam).



COMPLETED SPILLWAY LINING *(left)* is designed with slopes and curves to produce best hydraulic characteristics.



PANEL FORMS in 14x15-ft. units for concrete lining are held in place against rock wall of spillway cut by dowel bars grouted into holes drilled to 5-ft. depths. Crane boom is swinging bottom-dump bucket into place for discharge behind form panel.

BIDDING METHODS

Discussion of Article by Harry O. Locher

Favors Cost-Plus-Fixed-Fee Form of Contract

By A. B. MacMILLAN

Chief Engineer, Aberthaw Co., Boston, Mass.

To the Editor
of CONSTRUCTION METHODS:

IN RESPONSE to your request for discussions of the article "Bidding Methods" by Harry O. Locher, which appeared in the November issue of *Construction Methods*, the following comments are offered:

Many forms of contracts have been formulated in connection with construction work, a few receiving more or less general recognition. Of these, the following are typical examples: (1) Cost plus a fixed fee; (2) cost plus a percentage; (3) guaranteed outside cost; (4) guaranteed outside cost with bonus and penalty; (5) lump sum bid; (6) average bid. In the opinion of the writer, the majority of these methods have little or nothing to recommend them, only (1) and (6), above, being worthy of serious consideration.

"Any guarantee of outside cost means little or nothing unless the amount is arrived at as a result of some form of competition."

Cost-Plus-Fixed-Fee—This form of contract is probably the fairest that can be drawn up. Under it the owner pays only for what he receives and the contractor is paid a definite sum for his services. Obviously, in letting a contract of this type, the owner should assure himself that the firm employed is honest, experienced, skillful, properly equipped and organized. Its work should usually be handled on this basis, not on a lump-sum bid, because it is inevitable that the greatest concentration of effort will be placed by the building firm on those projects where it is taking the greatest risk of monetary loss. If, therefore, the bulk of its work is on a bid basis the attention given to the fixed-fee job will probably be less intense and the service rendered only lukewarm. The owner should also see that the builder has a satisfactory method of keeping records, accounting, etc., in order that he may at all times be informed in regard to progress made, obligations incurred, ultimate time of completion and cost.

The owner, under this form of contract, can pay all bills himself, take all discounts and make changes in plan at exact cost. He can start work sooner than he could on any bid basis and have the benefit of the builder's experience and knowledge of costs and materials during the preparation of plans and details when that experience and knowledge are unusually valuable to him.

The owner gains, also, in that all parties—owner, architect, and builder—are actively cooperating to one end: the completion of a structure promptly and as economically as may be commensurate with the quality required. The architect profits because he can give his time and effort to the perfection of the building and not to policing an unwilling or incapable workman into producing acceptable workmanship. The contractor gains because the gamble and the worry contingent on losses which he may incur on a lump-sum contract, are avoided. His best efforts can be given to the production of a structure which will be creditable.

It is sometimes stated that architects like this form of contract because they can cover up their mistakes. It is also said that the contractor cannot be held responsible for his errors or poor workmanship. In the writer's opinion, both of these assertions are wrong. The contractor cannot legally escape from the penalty of poor workmanship or incorrect interpretation of plans and specifications under this form of contract any more than he can under a lump-sum bid, nor does the architect avoid or cover up errors that he may have made by conniving with the builder to that end.

Cost-Plus-a-Percentage—This form of contract is more susceptible of abuse than the preceding one. In unscrupulous or careless hands costs can be run up, with increased profit accruing to the builder. Handled honestly, this form of contract is neither better nor worse than the fixed-fee type, but the element of uncertainty that is present makes it less desirable on general principles.

Guaranteed-Outside-Cost—It should be evident that any guarantee of outside cost means little or nothing unless the amount is arrived at as a result of some form of competition. Certainly no intelligent bidder would take some one else's estimate and guarantee it without a check-up, and unless the price is set by some one else or arrived at as a result of competition, the contractor will make it sufficiently high so that he can guarantee it without risk. If the price guaranteed is the result of competitive bids, then the contractor is worse off than he would be with a lump-sum contract. He is taking all the risks of the latter form of contract and at the same time limiting the profit he can make.

Guaranteed-Outside-Cost-with-Bonus-and-Penalty—Here, again, most of the evils of the guaranteed outside cost contract appear, with a few new ones added. Unless the estimate of cost is the result of competition the contractor will probably see that it is sufficiently high so that he makes a bonus in addition to his fair profit. As the bonus paid is ordinarily a percentage of the savings under the guaranteed cost, inducements are held out to scamp work, cut wages, substitute materials, use inferior subcontractors if they bid low, and chisel. If the guaranteed cost is determined in competition, the contractor is simply losing profit possibilities which he might have had on a lump sum bid.

Lump-Sum-Bid—From an owner's standpoint there can be only one possible advantage in this form of contract: He knows what he is going to spend at the start, provided his plans and specifications are complete and accurate in all details, his contract is air-tight, and no changes are authorized. For this knowledge he is content to cast aside control of quality and the sincere cooperation of his contractor because his interests are evidently quite divergent from the contractor's. He wants to get what he can—the contractor to save what he may. The architect becomes a sort of cross between a designer and a policeman, struggling with the desire to produce something good, knowing that he cannot prevent much that is poor. From beginning to end this form of contract on any involved, important work would seem to be a faulty and undesirable one, based on a general misunderstanding of the underlying factors that determine cost.

Neglecting the profit item, the actual cost of the average building may be broken down into groups such as materials purchased, subcontracts let, labor employed, plant rental and field organization cost. The first two of these items may be considered together. Combined, they total possibly 70 per cent of the total cost. Labor by the general contractor would probably not exceed 20 per cent; plant rentals and field organization about 10 per cent.

The quantity of materials required is fixed by the plans and specifications and is established by the estimator in his survey. The quality of materials is not so definite because of the modifying clause which appears so consistently in specifications "such and such a material or equal". This clause gives scope to wide variations. What is to be construed as equal, obviously, is anything that can be put across.

"How much consideration and weight are given to good management and good craftsmanship when low price is the main consideration?"

For any stated amount of material of a definite quality the price quoted to one contractor with reasonable financial standing is probably just the same, in the majority of cases, as that quoted to any of his competitors. The same is true of subcontract quotations. Any wide variation in this portion of the job must, therefore, usually represent variations of quality or chiselling.

In the labor item the maximum saving can be made not by better management but by wage cutting. If the wage rate can be cut in half, the general contractor can quote 10 per cent lower than the contractor who does not cut. It is also possible to cut the wages of the field organization and scamp workmanship. These are the methods by which extraordinarily low bids may be attained. It is the sweatshop of contracting.

Erecting a building is not solely a matter of buying materials and subletting contracts; it is a problem of management. The ability to manage and the quality of craftsmanship varies not only with individuals but with companies. Good management involves experience, decisiveness and honesty. Good craftsmanship requires natural aptitude and training. How much consideration and weight are given to these requisites when low price is the main

consideration? For this purpose the contractor mainly needs, as equipment, the will to take a chance, backed by the intent to use any means that may be necessary in order to make a profit. It is hard to understand how intelligent people are willing to become parties to such a gamble.

Average-Bid-Contracts—Letting contracts on the basis of the average bid has not been widely adopted. Nevertheless, this form of contract is the logical one when competition is desired and the cost of the work determined definitely before commitment. To be entirely satisfactory certain safeguards should be established; the following are suggested:

(a) Requests for bids should state that the work is to be let on this basis; (b) the names of acceptable subcontractors in the various trades from whom bids may be received should be stated in the specifications; (c) the general bid should be accompanied by a data sheet containing the names of the subcontractors included in making up the general bid and the price they quoted; (d) the bids should be opened publicly; (e) they should be tabulated in the order of their magnitude; (f) approximately 25 per cent of the bids at the high end of the tabulation and an equal number at the low end should be discarded; (g) the middle group remaining should be averaged and the contract awarded to the bidder nearest the average on the low side. If two or more bids are exactly the same and occupy this position, the work should be awarded to the company whose experience, organization, equipment, credit and past performance are the better.

"Erecting a building is not solely a matter of buying materials and subletting contracts; it is a problem of management."

This form of contract does not eliminate all gamble for the contractor, but at least it makes the competition as fair as any competition can be, because each contestant must earnestly strive to translate the intent of the plans and specifications into dollars and cents as accurately as he may in order to have any chance of winning the award. Discarding the top and bottom groups is done for the purpose of eliminating bids containing mistakes, careless pricing, lack of knowledge or experience, etc.

This form of competition in contract letting is not ideal, perhaps, but is far better than the low-bid competition that is rampant at present. If adopted, it would be attractive to good builders and would insure better buildings.

A. B. MACMILLAN
Chief Engineer,
Aberthaw Company
Boston, Mass.

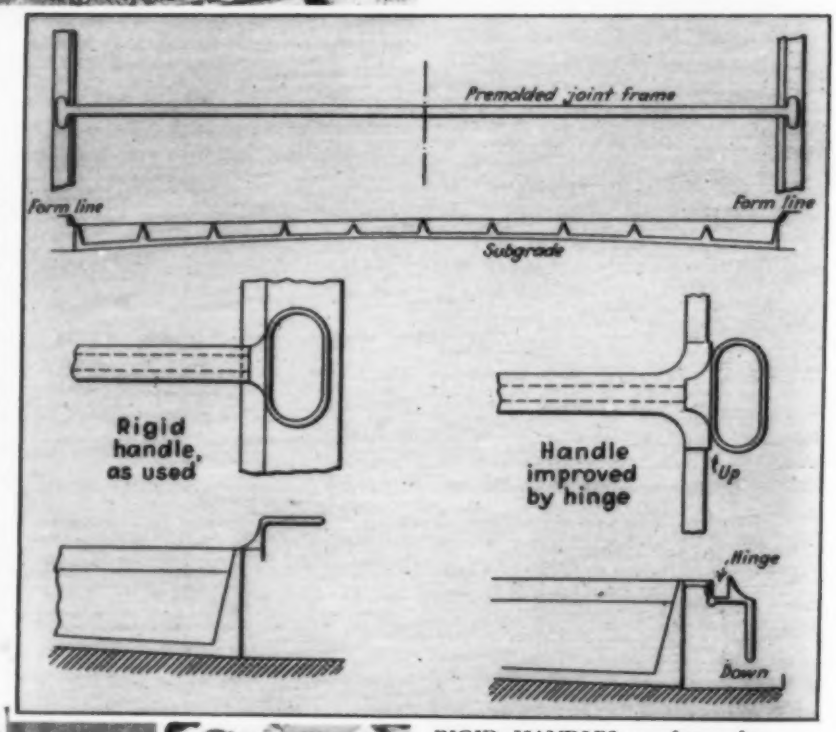
Mechanical Strike-Off *Increases Paving Production*

By T. C. THEE and S. T. HITCHCOCK
Division of Management, U.S. Bureau of Public Roads

PLACING 10x20-ft. steel mesh. A skilled mixer operator can lighten work for puddlers by properly spreading concrete with mixer bucket.

EXPERIENCE HAS SHOWN that where steel mesh or steel mat reinforcement is required it can be placed in the road slab more readily and more accurately if the concrete is first struck off at the level at which the steel is to be placed. The mesh or mat is then readily laid exactly as desired on this surface and covered with the additional concrete. However, when production rates are high, the operations of spreading the concrete in two courses, striking off the first course to the proper height and section, placing the steel and then spreading the second course are apt to interfere with the steady production of the mixer unless all details are carefully planned and fully coordinated.

Hand methods for striking off the first course are usually satisfactory only when production rates are comparatively low. This also holds true for using the finishing machine for this purpose. When the paver operates between the forms the boom and bucket prevent use of the finishing machine as a strike-off, while if the paver operates on the shoulder or side, the speed of the finisher is not sufficient to perform both operations of finishing and striking off the base except when production rates are low or the width of the slab being poured is not much less than 20 ft. These difficulties have led to the development and use of mechanical strike-offs drawn by a winch or cable windlass mounted on the paver.



RIGID HANDLES on frame for holding premolded expansion joint *(at left)* interfere with passage of strike-off machine. HINGED HANDLES *(at right)* offer no obstruction.

WITHOUT USE OF MECHANICAL STRIKE-OFF it is difficult to place mesh in proper position in slab and complete this operation without delaying mixer.

These mechanical concrete strike-offs consist essentially of a sturdy template riding on the forms in much the same manner as the subgrade planer and are so

adjusted that when drawn forward by the windlass the concrete is struck off at the proper height for placing the steel mesh. The operating procedure is both rapid and simple. When sufficient concrete has been spread to provide a base for at least one length of steel, the windlass simply pulls the strike-off forward the desired distance. The concrete should be spread to such depth that a fair load will always be carried in front of the strike-off blade. After having been pulled ahead the desired distance the strike-off is left standing while the steel is placed and the surface course poured. The strike-off is also left standing while the mixer is moved ahead.

The blade of the strike-off can be raised by means of a lever at each end so as to permit the machine to pass over the forms used in setting the joints. On one recent job the frames for holding the pre-molded expansion joints had handles (see sketch, facing page) which were so shaped that they interfered with the passage of the strike-off machine. Consequently, batches usually had to be split at every expansion joint. This entailed a considerable unnecessary loss of time and reduced production. Had the form handles been made flat or provided with a hinge, the strike-off machine could have passed over the expansion joints by simply raising the blade, and no splitting of batches would have been necessary.

striking off the concrete and placing the steel. The average rate of production was 42.0 batches or 49.8 cu. yd. per hour, with a maximum possible rate of 66.3 cu. yd. per hour. Two men worked on the mixer subgrade planer, four men placed joints and steel, and four men puddled and spaded the concrete.

The second job operated at an average rate of 48.5 batches or 59.4 cu. yd. per hour, with a maximum possible rate of 70.5 cu. yd. per hour. Only two men were required both to handle the strike-off planer and to place the joints. Two other men handled steel mesh, one man placed the dowel bars and two men puddled and spaded the forms. Work on the mixer subgrade planer was done by the two men placing the joints. On this job the time losses due to operations connected with striking off the concrete and placing the steel and joints absorbed only 3.03 per cent of the time the paver actually operated. Of these losses 2.28 per cent were due solely to the difficulty of passing the strike-off planer over the type of frame used for holding the expansion joints. A slight change to a hinged handle on the frame of the joint holder so that the strike-off could have been moved over the joint without delay, would, in all probability, have reduced the total time losses connected with the spreading of the concrete and setting the steel to about 1.0 per cent of the actual operating time.

Even without this change, the second job, which used the mechanical strike-off, lost less than one-half as much time from operations connected with placing the steel as did the first job which used hand methods. Thus, the first job lost 7.4 per cent of the working time in operations connected with placing the steel, while the second job lost on these operations a total of only 3.0 per cent, of which more than half was due to the use of a faulty joint frame.

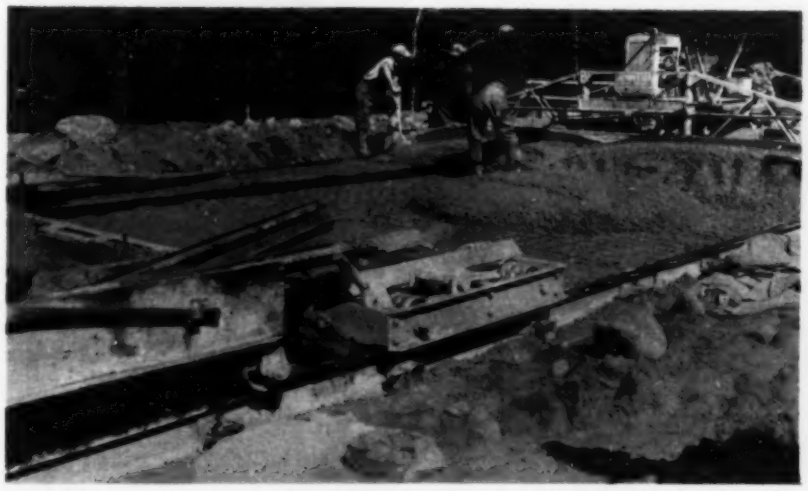
In addition, the actual rate of production secured on the second job was about 19 per cent higher than on the job using the hand methods. With operating time of the paver worth at least 75 cents a minute, it is clear that the use of the mechanical strike-off was, in this case, a decidedly paying proposition.

TABLE 1—SUMMARY OF TIME LOSSES AS SHOWN BY STOP-WATCH STUDIES

Minor delays which occurred during time of actual operation—each delay less than 15 min. in duration.

PERCENTAGE OF ACTUAL OPERATING TIME LOST

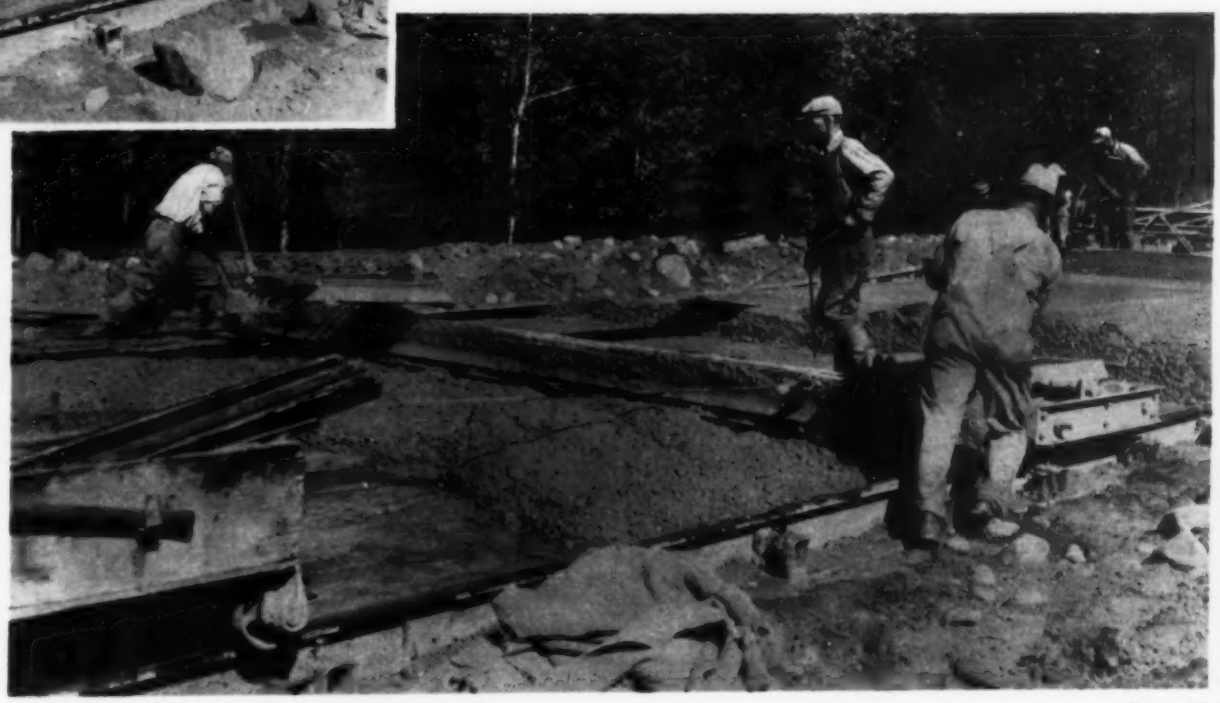
Cause	Job 1 Per Cent	Job 2 Per Cent
Placing steel and striking off concrete	2.35	0.42
Placing joints and moving strike-off	0.91	1.18
Split batches	0.74	0.75
Mixer, operator		2.28
Mixer, mechanical	6.65	
Hauling unit, supply	3.21	3.00
Hauling unit, operation	1.64	4.44
Subgrade	6.97	2.79
Water supply	0.34	0.40
Lip curb		0.68
Handling cement	0.51	
Miscellaneous	1.38	0.56
Totals	24.90	16.50



WHEN SUFFICIENT CONCRETE is spread to provide base for at least one length of steel, windlass pulls strike-off planer forward required distance. Steel is then placed and surface course poured and struck off by finishing machine.

STRIKE-OFF PLANER makes it possible to place steel mesh in road slab more readily and more accurately.

Operating Losses—Table 1 shows the time operating losses as observed on two jobs, the first of which used hand methods for striking off the concrete before placing the steel, while the second used a mechanical strike-off. On Job 1, ¼-in. steel of 6-in. mesh in sheets 10x9½ ft. were placed on the concrete as spread and struck off by hand 2 in. below the surface. On this job 7.4 per cent of the time the paver actually operated was lost due to operations connected with spreading or

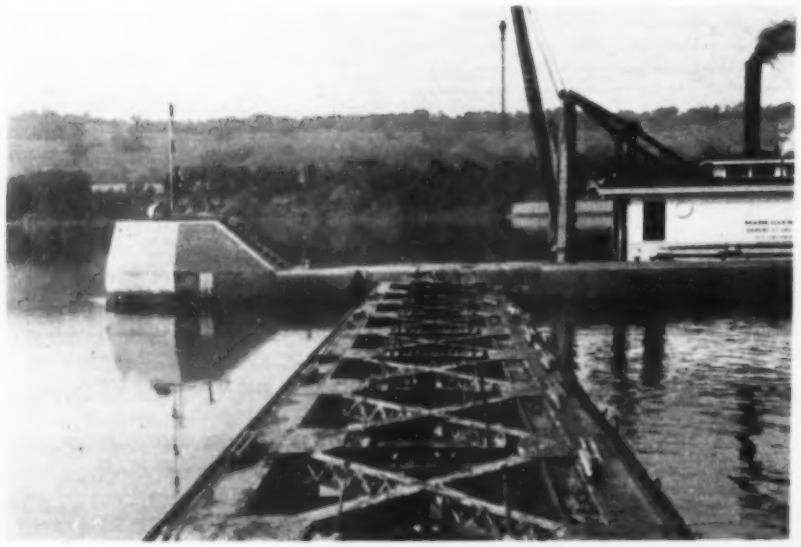


RAISING *(right)* **strike-off planer allows it to be pulled over expansion joint.**

Step-by-Step Field Methods

REPLACING ROLLING GATES

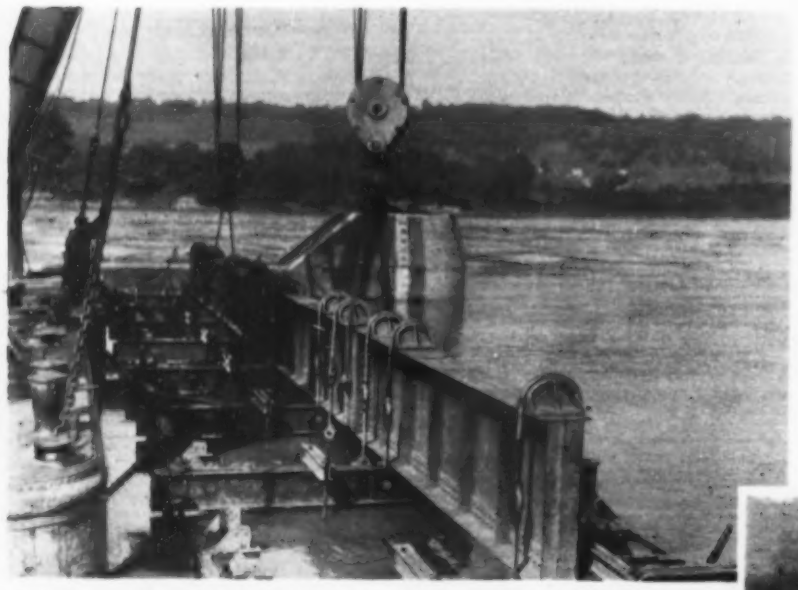
at Ohio River Lock



1 OLD ROLLING GATE at upper end of lock being prepared for removal and replacement by new gate. Note top truss, plates on top beams and short top rods spread apart so gate could be operated.

TO PREVENT DELAY to navigation on the Ohio River during replacement of upper and lower lock gates, weighing 120 and 160 tons respectively, at Lock 37, 13 mi. below Cincinnati, the U. S. Engineers applied a scheme using two floating 90-ton-capacity A-frame hoists to lift the old gates intact and to place the new gates, weighing 120 tons each, in complete units. The two old gates were removed and the new gates accurately set in position within 54 hr. during which an open river stage for safe navigation across the dam was maintained by skillful manipulation of the upstream dams.

Lock 37 is equipped with gates of the rolling type. Each gate, 116 ft. long, 12 ft. wide, and about 22 ft. high, is supported by ten axles mounting two



2 LIFTING RIGGING on lower gate consists of lifting beams, hoist girders and short beams of auxiliary hook-up which provided rods to carry load of old, rusted gate on axles, when raised.

3 RAISED CLEAR of WATER (*left*) by booms of two 90-ton floating A-frame hoists, side by side, the old gate is ready to be carried upstream, turned through an angle of 90 deg. and deposited upon the lock esplanade. Note flanged wheels on which gate operated on track across lock.

4 FLOATING HOISTS, with old gate suspended from A-frame booms, move out of lock chamber to deposit their load on esplanade upstream. Lower gate weighs 160 tons, is 116 ft. long, 12 ft. wide and 24 ft. high.

5 NEW GATE is floated into lower end of lock chamber, on barge, assisted by derrick boat. Lifting tackle on A-frame hoists will be attached when gate is swung around into position for lowering.

6 IN POSITION, (*right*) across lower end of lock, new gate is ready to be hooked up to lifting tackle from floating hoists and raised from barge.

wheels each. The twenty wheels travel on two rails which run straight into a recess in the land wall. In appearance, each gate resembles a deck-truss bridge turned on its side with a wood bulkhead on the upstream face to take the water pressure.

A river stage low enough to permit replacement operations to begin was reached on June 5, 1933. Because of the rusted condition of the old gate frames, it was thought advisable to em-

7 LOWERED TO PLACE. New gate has descended in to position on submarine track across lower end of lock chamber.

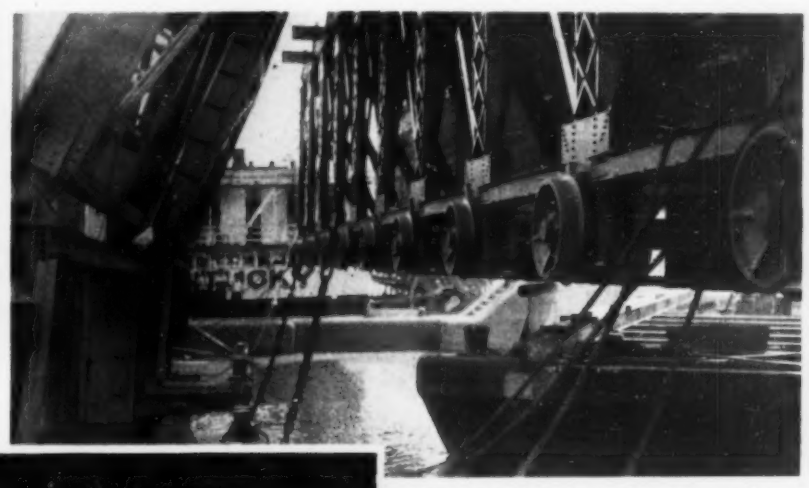
ploy a lifting rigging which would place the weight of each gate on the axles. The rigging was installed on the upper gate during the night, and, after some minor difficulties, the two hoists raised the gate clear of the water at 10:30 a.m. and placed it on the lock esplanade at 11:05 a.m., June 6.

Barges carrying the new gates had been brought near the lock during the night. Proceeding to a point above the lock, the two A-frame hoists, side by side, lifted the new upper gate off its barge, floated backwards across the gate tracks, and lowered the gate within 6 in. of the tracks. By inserting 2x4-in. timbers between the vertical water seal members of the gate and the lock recess walls, the gate then was guided accurately to final position. At 6:25 p.m. a diver reported all wheels on the tracks and wedges removed.

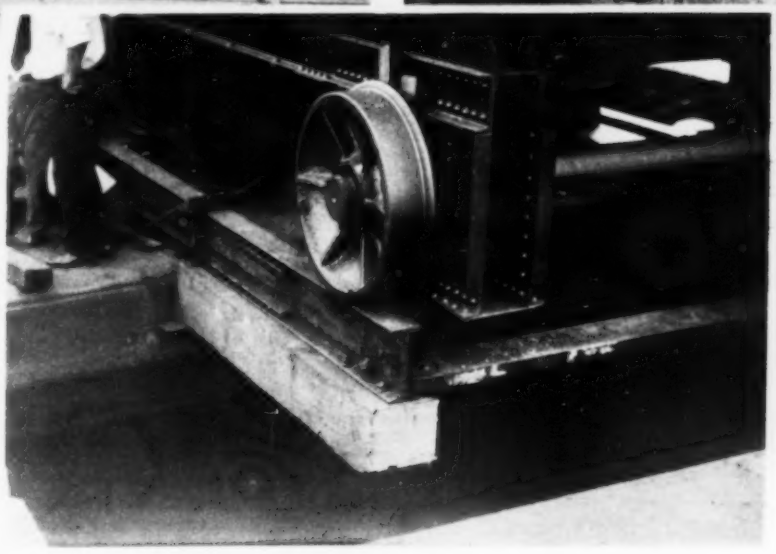
Similar methods served in replacing the lower gate. The new lower gate was lowered to its tracks by 4:55 p.m., June 7, and was pulled into its recess at 9:15 p.m.

Under Lieut. Col. C. L. Hall, district engineer, the work was directed by Lieut. D. T. Johnson, engineer in charge. L. H. Prell acted as assistant engineer and James E. Rice as general foreman.

8 FLANGED WHEELS (*above*) support new lower gate on steel girder rails along deck of barge.



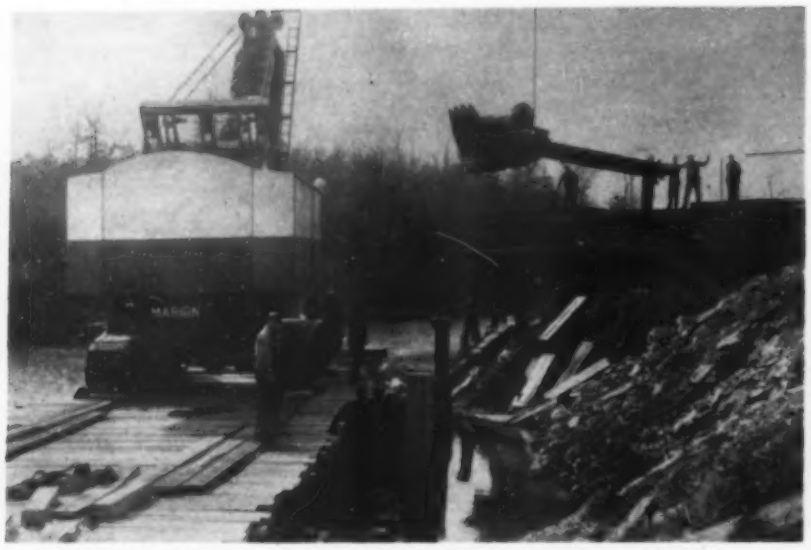
9 BARGE is floated out from under as new gate is raised by A-frame hoists and held, suspended above water, prior to lowering.



10 MOUNTING of gate is on axles and flanged wheels to permit operation on under-water track across end of lock.

100-TON SHOVELS

Floated to Wheeler Dam



LOADED ON BARGE, 100-ton shovel is supported by double plank floor on six 3-ft. I-beams. Dipper and dipper stick are being swung aboard.

LEE HUNTLEY *(left)*, superintendent of construction, and W. M. HALL *(right)*, construction engineer, turn away from loading dock as shovel moves safely aboard barge.

DELIVERY of construction plant and equipment needed in building the $22,000,000 General Joe Wheeler dam on the Tennessee River by the Tennessee Valley Authority may be accomplished almost entirely by water, since the site of this project is on slack water 15 mi. above Wilson dam at Muscle Shoals, Ala., where main-line rail connections are available. The cost of building a railroad to serve the project is thus eliminated, but careful planning is required to handle some of the larger units, including two 100-ton electric-power crawler-mounted shovels for stripping the 500,000 cu. yd. of rock and overburden that must be removed in preparing power house and spillway foundations.

Both shovels arrived from the factory by rail at a point ¼ mi. from the edge of the Wilson dam reservoir. After being assembled there, each shovel was run overland to the edge of an inlet of the reservoir where there was no danger of wave action. At that point a temporary crib loading dock was built so that each shovel could run under its own power on to a deck shored up specially on a 30x70-ft. steel-hull barge.

Six 3-ft. steel I-beams were laid on the regular deck of the barge in pairs, with steel X-bracing between each pair to prevent overturning. A double floor of 3-in. planking was laid crosswise on the steel beams. Lengthwise planking also was placed under the treads of the crawlers further to distribute the load as the shovel mounted the barge.

After the barge was shifted into position with one end against the loading dock, two spuds on each side of the barge were dropped to take bearing on the bottom. With the barge thus anchored, the heavy shovel could safely be run upon it. After the shovel was loaded, the spuds were eased off slowly to make sure the barge was on an even keel.

START of 15-mi. trip up river to Wheeler dam. Note I-beams on barge cross-braced to prevent overturning.

UNLOADING *(below)* starts as barge is backed up to crib ramp and anchored by spuds.

A small power boat handled the barge as a push tow on the 15-mi. trip to the cofferdam surrounding the site of the power house at Wheeler dam. A gap had been left in the shore end of the downstream leg of the cofferdam through which the barge could be floated. To facilitate unloading the shovel, a rock-filled timber-crib unloading dock was built in shallow water near the shore line. The barge was shifted around to bring one end firmly against this dock. Then the four spuds were lowered to good bearing on the bottom to hold the barge in place while the shovel was run off on the unloading dock. From the dock the shovel was run down a ramp to the river bottom in the cofferdam after the latter had been unwatered.

Both shovels were successfully moved in this manner. Each shovel was 5 hr. from the time it was shunted to the loading dock until it was on the unloading dock in the cofferdam.

A. E. Morgan, chairman of the Tennessee Valley Authority, has general charge and C. H. Locher is consultant on all construction operations of the Authority. W. M. Hall is engineer of construction and Lee Huntley, as superintendent, is in charge of construction of the General Joe Wheeler dam for the Authority.

Present and Accounted For —

Contractors' Divisional Code Authority Members

National Recovery Administrator Hugh S. Johnson has announced recognition of the industry members of the General Contractors' Divisional Code Authority as follows:

**E. MARSHALL RUST, Treasurer,
Rust Engineering Co.,
Pittsburgh, Pa.**

A. E. Horst,* *chairman*
Henry W. Horst Co., Philadelphia

A. C. Tozzer,* *vice-chairman*
Turner Construction Co., New York

E. Marshall Rust, *treasurer*
Rust Engineering Co., Pittsburgh

W. F. Austin
W. E. Wood Co., Detroit

E. T. Foley
Foley Bros. Inc., Pasadena, Calif.

E. P. Forrestel
Cold Spring Const. Co., Akron, N. Y.

N. F. Helmers*
Siems-Helmers, Inc., St. Paul, Minn.

W. A. Klinger
W. A. Klinger, Inc., Sioux City, Ia.

R. E. O'Connor*
J. C. O'Connor & Sons, Ft. Wayne, Ind.

E. P. Palmer
Senior & Palmer, New York

L. E. Ray
Diamond Engineering Co.,
Grand Island, Neb.

F. L. Shackelford
Potter & Shackelford, Inc.,
Greenville, S. C.

H. B. Zachry,
Zachry Co., Laredo, Tex.

W. C. Miller,
W. C. & A. N. Miller, Washington, D. C.

C. H. Simpson
Municipal Paving & Construction Co.,
Nashville, Tenn.

R. A. Whidden
Whidden Const. Co., Boston, Mass.

J. B. Bray
W. W. Boxley & Co., Roanoke, Va.

E. J. Harding, managing director of the A.G.C., Washington, D. C., has been named secretary, and Louis W. Hickey, Dallas, Tex., executive manager, for the Divisional Code Authority.

*Also member, Construction Code Authority; photo in March issue.

**W. F. AUSTIN
W. E. Wood Co.,
Detroit, Mich.**

**W. A. KLINGER
W. A. Klinger, Inc.,
Sioux City, Ia.**

**E. P. PALMER
Senior & Palmer,
New York, N. Y.**

**L. E. RAY
Diamond Engineering Co.,
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**F. L. SHACKELFORD
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**W. C. MILLER
W. C. & A. N. Miller,
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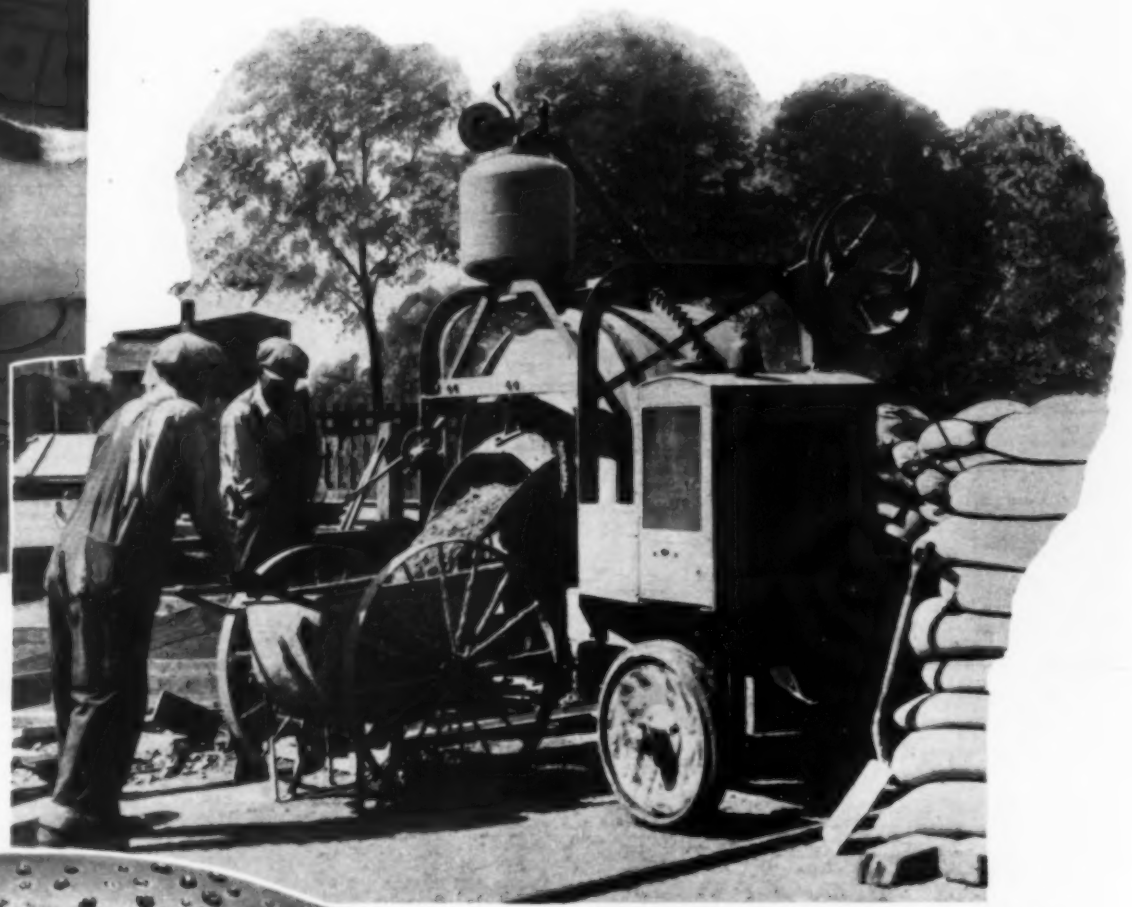
**C. H. SIMPSON
Municipal Paving & Construction Co.,
Nashville, Tenn.**

**R. A. WHIDDEN
Whidden Const. Co.,
Boston, Mass.**

**J. B. BRAY
W. W. Boxley & Co.,
Roanoke, Va.**

NEW EQUIPMENT

ELECTRIC ERASING MACHINE, held in fingers like pencil, enables operator to maintain accurate finger control when erasing pen or pencil lines from tracings or drawings. Machine, combining lightness and compactness, is operated by self-contained a.c. or d.c. motor. Complete assortment of pen and pencil erasers furnished with machine.—Charles Bruning Co., 445 Plymouth St., Chicago, Ill.



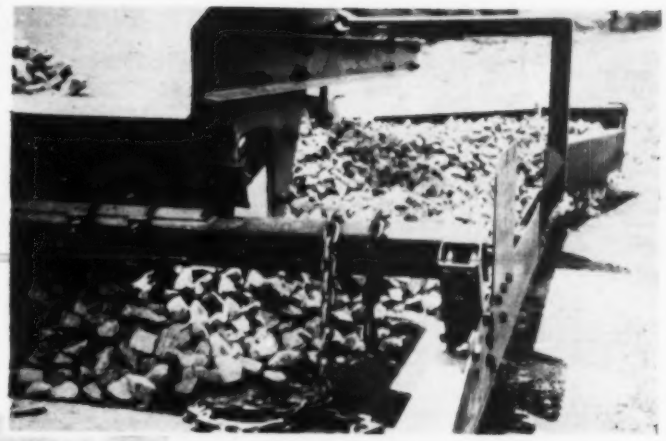
LIGHTNESS OF WEIGHT combined with speed in operation is outstanding characteristic of Dandie 2-bag mixer *(above)* which, in addition, possesses following features in its design: Full floating—on springs; frame, 88⅞ in. long; equipped with anti-friction bearings; roomy skip with skip shaker; automotive type steering; accurate syphon-type self-cleaning water tank; fast and clean charging and discharging; axle stabilizers——centralized control; Le Roi engine, and multiple V-belt drive. Weight, 3,800 lb.—National Equipment Corp., N. 30th St. & West Concordia Ave., Milwaukee, Wis.

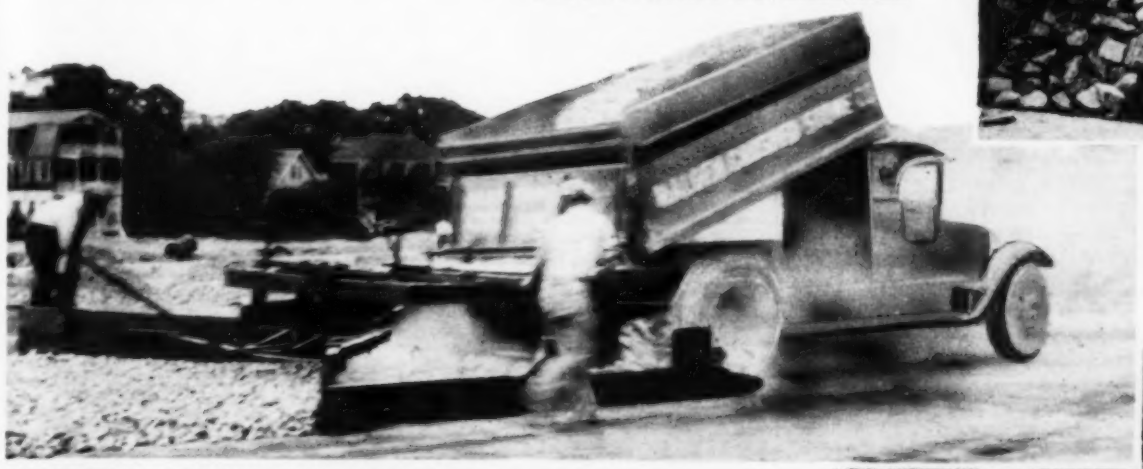
PUNCTURE-SEALING automobile tire tube, called "Seal-o-matic", incorporates layer of plastic gum inside tube wall. When puncture occurs, this rubber flows into hole sealing it without appreciable loss of air. Nails are driven into tire containing new puncture sealing tube with result shown in insert above. Light weight of tube permits it to be used on smallest cars.—B. F. Goodrich Co., Akron, Ohio.

FLEXIBLE DRUM ARRANGEMENT consisting of two side drums and one front drum, each rotating independently and having three forward and one reverse speeds, provides versatility for "Hustler" crane *(below)* in handling material, industrial equipment, logs and pipes, and in converting to clamshell, scraper, piledriver or tractor service. Crane has 3-speed traction with 5.2 m.p.h. travel speed, 2.6 m.p.h. ordinary working speed and 1.3 m.p.h. when power demands are severe. With counterweight, machine picks up 12,000 lb. at 6-ft. radius; without counterweight, 5,200 lb. at 4-ft. radius; with stiff-leg under boom, 35,000 lb.—Harnischfeger Corp., Milwaukee, Wis.

on the Job

SIMULTANEOUS SPREADING AND FINISHING with all sorts of road materials is accomplished by this Nickerson road finisher *(at right and below)* which is attached to rear of truck and drawn forward while truck is dumping. Adjustable in width up to 15 ft. and in depth from 0 to 8 in. Specially constructed 10-ft. shoes lay material smoothly preventing "tilting". Easily shifted while in motion to take care of various spreads and depths of road bed. Two minutes or less for entire operation of attaching, spreading and detaching. Length over all, 14 ft.; width, with runners closed, 9½ ft.; weight, 3,000 lb.—Peterson & Neville, Inc., 365 Dorchester Ave., Boston, Mass.



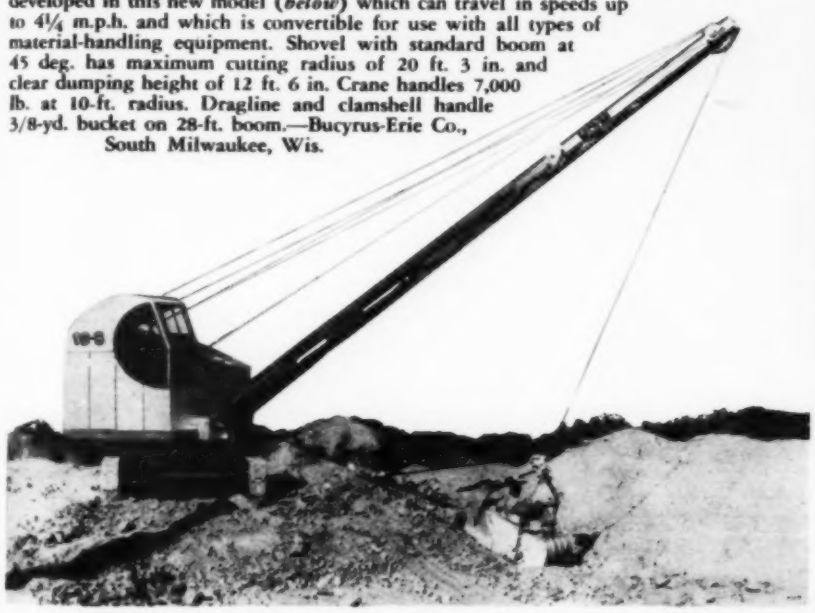


If You Want Further Information—

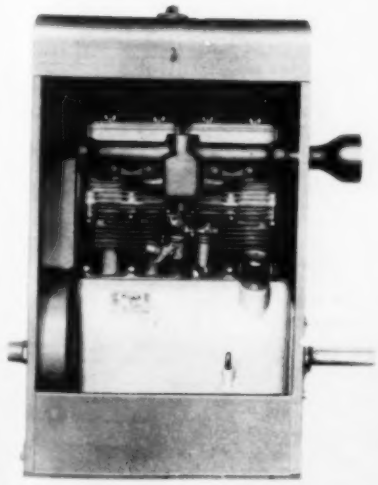
Within the space limits of this page it is impossible to present complete information about the products illustrated.

The manufacturers, however, will be glad to supply further details if you will write to them.

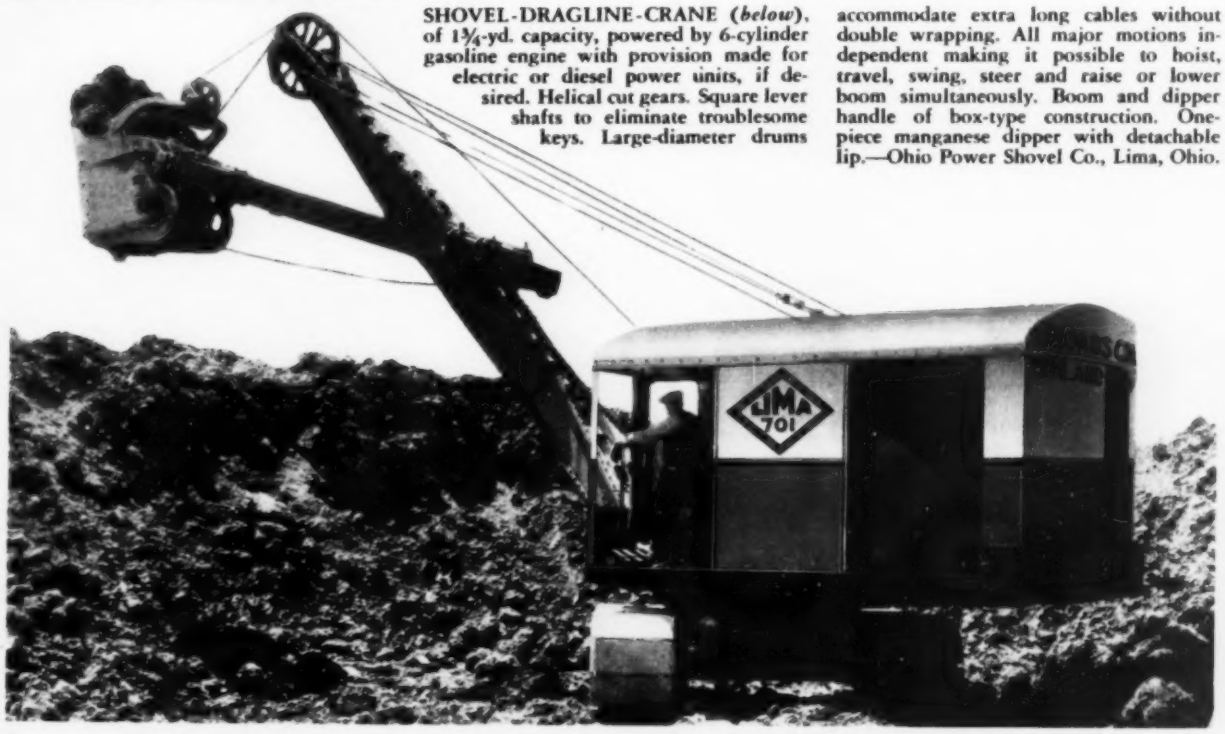
AN UNUSUALLY MOBILE full-revolving 3/8-yd. excavator has been developed in this new model (*below*) which can travel in speeds up to 4¼ m.p.h. and which is convertible for use with all types of material-handling equipment. Shovel with standard boom at 45 deg. has maximum cutting radius of 20 ft. 3 in. and clear dumping height of 12 ft. 6 in. Crane handles 7,000 lb. at 10-ft. radius. Dragline and clamshell handle 3/8-yd. bucket on 28-ft. boom.—Bucyrus-Erie Co., South Milwaukee, Wis.



MINERAL-SURFACED ASPHALT BRIDGE PLANK, made by embedding coarse trap rock under hydraulic pressure into fibrous asphaltic body of plank, retains all advantages of older-type, smooth-surfaced product, with added feature of greatly improved traction when wet. Characteristics: Light in weight; easily applied; will not warp, crack, splinter or decay. Being resilient, it will stand considerable vibration and deflection. Ready for traffic as soon as laid. May be had in thicknesses ranging from 1 to 1½ in., in 12-in. widths and 24-in. lengths.—Johns-Manville, 22 E. 40th St., New York City.



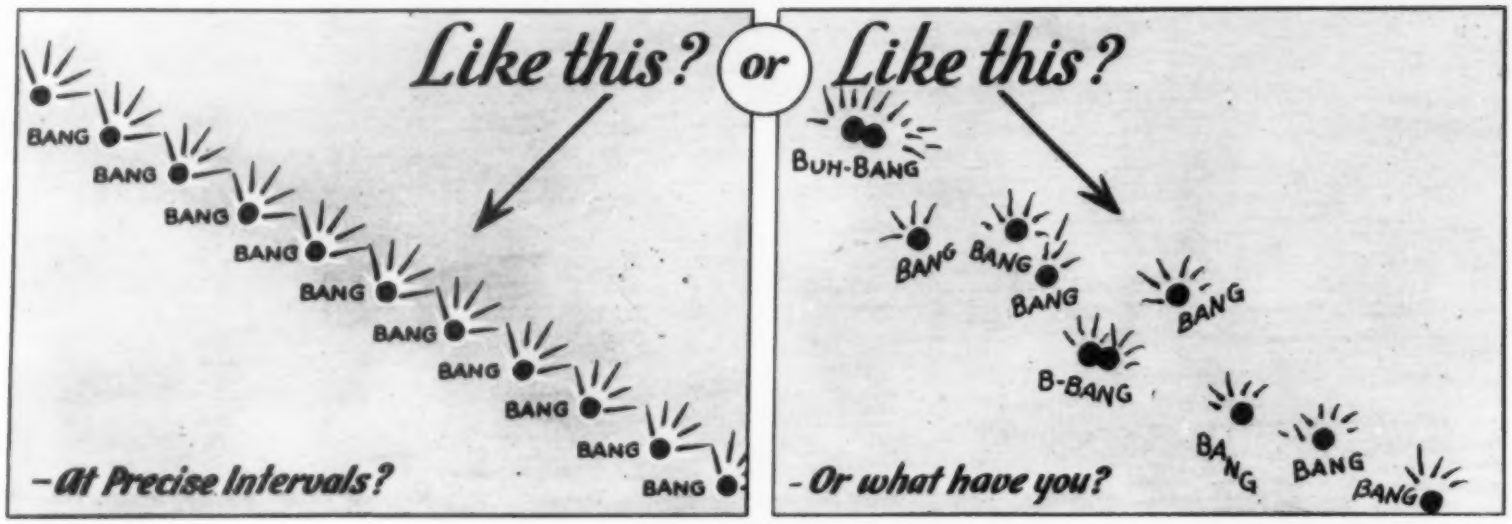
AIR-COOLED ENGINE of heavy-duty, 4-cylinder, 6- to 16-hp. capacity type has 2⅜-in. bore and 3¼-in. stroke with piston displacement of 70.35 cu.in. Develops 10 hp. at 1,350 r.p.m., 12 hp. at 1,600 and peak of 16 hp. at 2,600 r.p.m. Outstanding feature is light weight, engine and accessories weighing 215 lb. and complete unit 265 lb. — Wisconsin Motor Corp., Milwaukee, Wis.

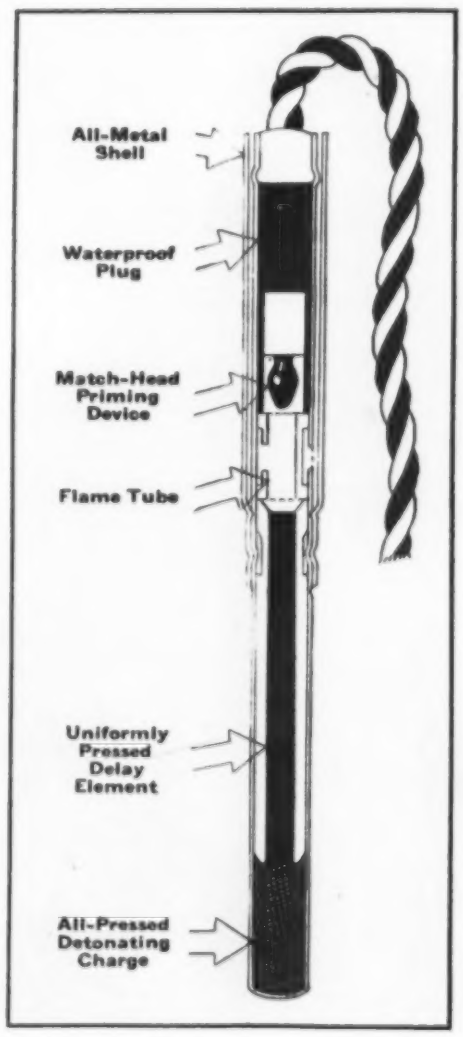


SHOVEL-DRAGLINE-CRANE (*below*), of 1¾-yd. capacity, powered by 6-cylinder gasoline engine with provision made for electric or diesel power units, if desired. Helical cut gears. Square lever shafts to eliminate troublesome keys. Large-diameter drums accommodate extra long cables without double wrapping. All major motions independent making it possible to hoist, travel, swing, steer and raise or lower boom simultaneously. Boom and dipper handle of box-type construction. One-piece manganese dipper with detachable lip.—Ohio Power Shovel Co., Lima, Ohio.

HOW DO YOUR SHOTS SAY BANG

in delay electric blasting





ONE means accuracy of delay in firing—perfect firing. The other means inaccuracy—overlapping—and bad blasting. Listen to the firing of Atlas All-Metal Delay Electric Blasting Caps for a *sound demonstration* of how regular and how accurate firing can be—and *must* be for best results. Look to Atlas for outstanding advantages in construction and design, that have definitely placed the Atlas Delay in a position of leadership.

The Atlas All-Metal Delay Electric Blasting Cap was originally announced in 1928. It was the *first* Delay with an all-metal shell to appear on the market. Today it is the *foremost* Delay in the field.

The Atlas All-Metal Delay Electric Blasting Cap has no rubber tube—no fuse. Its construction affords full moisture resistance—its unique safety features effectively guard against accidental firing. It assures accurate timing—*all* of the time!

Put *your* delay electric blasting on a better basis—a more economical basis. Do away with misfires and overlapping. Let the Atlas representative show you how to make your shots say "bang" in the way that makes the most from every delay blasting operation.

ATLAS POWDER COMPANY

A proper explosive for every blasting requirement

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ATLAS

ATLAS EXPLOSIVES

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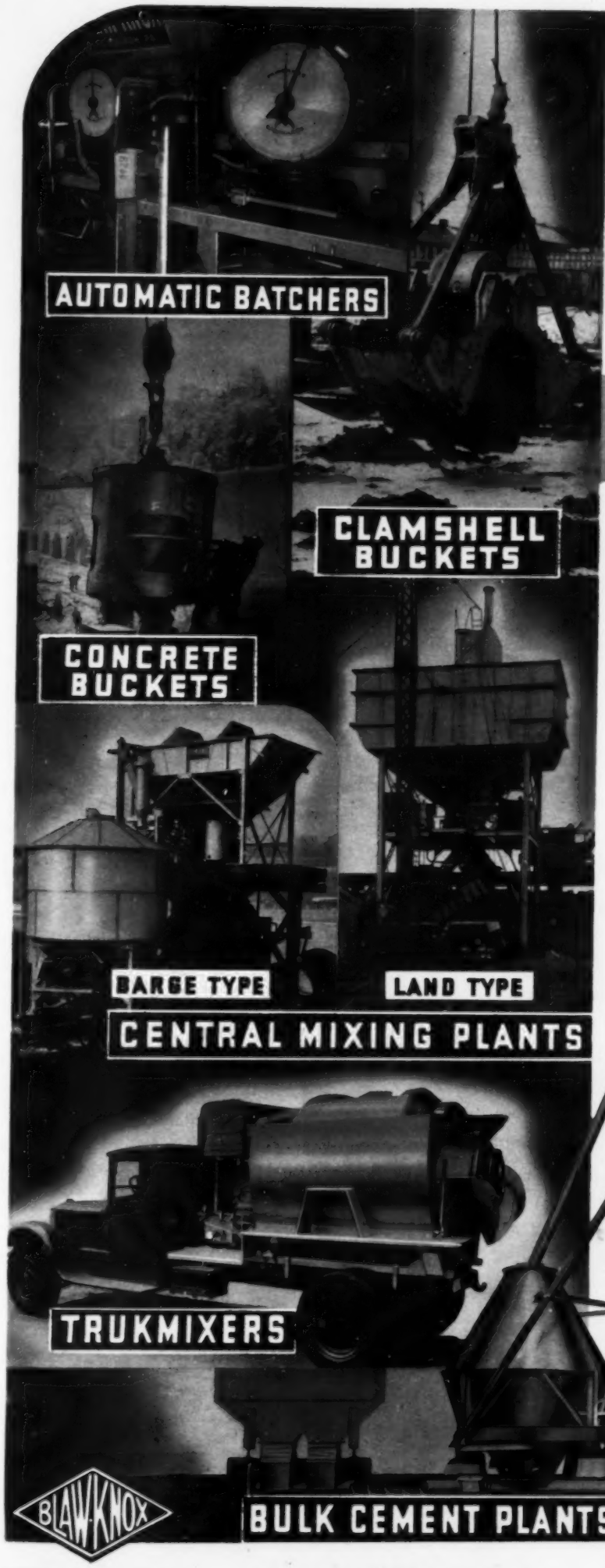
EXPLOSIVES



BLAW-KNOX EQUIPMENT

FOR FASTER → → → → MORE PROFITABLE WORK

MORE than ever before, the Blaw-Knox 1934 line of construction equipment exactly fits contractor's present and future requirements. New developments and amazing improvements in equipment are in step with projected programs and specifications.

Blaw-Knox equipment helps the contractor to maintain schedules and complete his work on time. It is low in maintenance cost and pays for itself quickly in service. It is modern and in many instances has anticipated specifications. Blaw-Knox equipment helps the contractor to make profits in the face of severe competition.

It's a twenty-eight year old custom among contractors to "deal with Blaw-Knox." This is an especially good habit to continue as it marks the maximum worth in equipment, satisfaction and service to be obtained for the dollar expended.

BLAW-KNOX COMPANY
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BLAW-KNOX LEADERSHIP CONSTRUCTION EQUIPMENT also includes:—

Steel Forms for General Concrete Construction
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BLAW-KNOX

● The one *positive* way to determine in advance exactly what truck is best fitted for any particular hauling job is through the Reo Ability Rating System and the Reo Truck Performance Gauge.

The Ability Rating Plate is in plain view on every truck shipped from the Reo factory. It shows the maximum gross load capacity of the truck, percent of grade the loaded vehicle will make in high gear, and the safe loaded speed on level highways.

Thus there is no guessing about what to *expect* of a Reo after it is put in service.

You know that the famous Reo-built Gold Crown Engine will easily deliver what the plate specifies—and you can safely gauge your schedules accordingly.

You know that Reo trucks are built right as well as sold right—that they must possess *extraordinary quality features* to justify Reo in making such a specific forecast of RESULTS.

Equally important to long life and low-cost operation is a correct advance analysis of your *requirements*. These are determined quickly and accurately by the Reo Truck Performance Gauge. In the hands of a specially schooled Reo salesman, it gives the answer to such vital questions as tire sizes, axle ratios and power. Reo offers this analysis without obligation. Write Reo or call your Reo dealer.

Reo Speedwagons and Trucks range from ¾ to 4-6 tons. New low prices—$530 and up. 32 wheelbases, all with Reo Gold Crown Engines. Tractor-Trailer units with correct load distribution and maximum pay load capacity. All prices chassis f. o. b. Lansing, plus tax.

Use This Book In Choosing Your Next Truck!

This book will serve you as an excellent guide in the correct selection of your next truck. In addition to the 15 superiorities with which Reo challenges the field for low cost truck performance, it supplies accurate and invaluable data with which you may compare all trucks in the low price range. Why buy a truck without first looking into the facts and making sure of getting the most value for your money? Write Reo today for the "Truck Superiority Book." No cost, no obligation.

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THE QUALITY TRUCK IN THE LOW PRICE FIELD

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Presenting the JAEGER-LAKEWOOD Automatic Finisher

Flexible as Steam
Adapted for Concrete or Bituminous
Higher Speeds with Real Velvet Touch

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- Speeds 8 to 12 ft. per minute forward, 40 to 90 ft. reverse.
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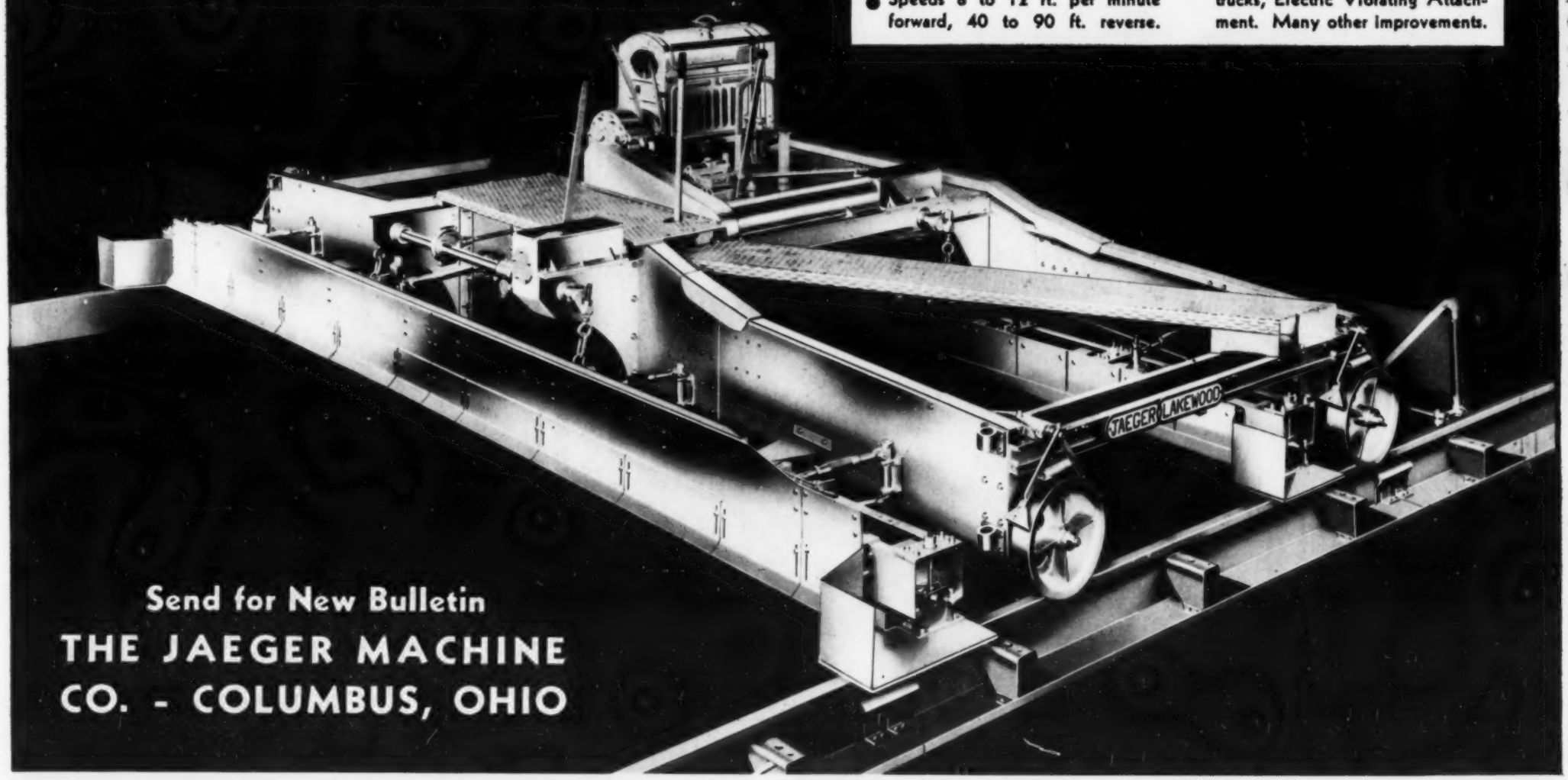
- 14" Wheels mounted outside trucks, Electric Vibrating Attachment. Many other improvements.



Send for New Bulletin

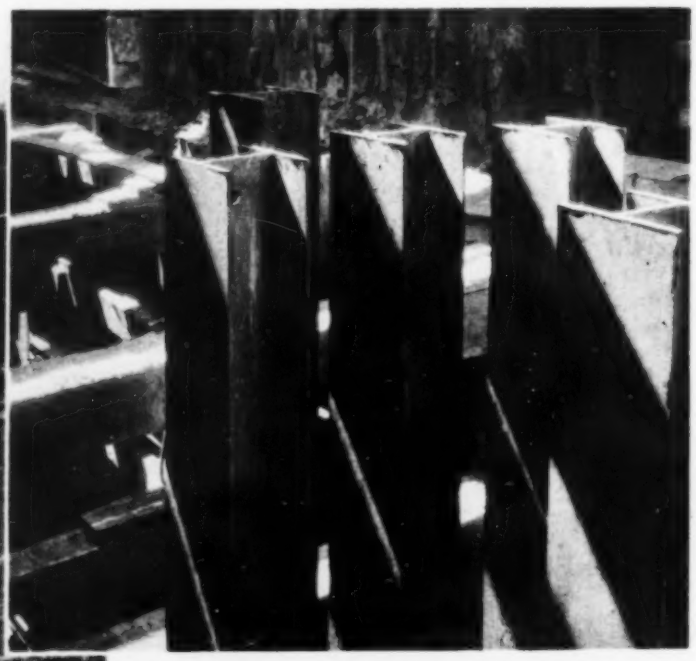
THE JAEGER MACHINE CO. - COLUMBUS, OHIO

Here is the New AUTOMATIC Finisher

C B SECTIONS

for bearing piles under bridge foundations

One of the longer piles on the Kansas River Bridge, ready to be driven. Other shorter piles in the foreground show method of pointing and reinforcing web at lower end. Many of the piles were driven without this reinforcing or pointing and without any difficulties in driving.



A typical bell cluster of H-piles [C B Sections]. Driving has been completed. Note condition of tops. Kansas River Bridge built by Kansas State Highway Department. Designing Engineers: Sverdrup & Parcel. Contractors: Kansas City Bridge Company.

C B SECTIONS have been successfully employed as bearing piles under the foundations of a number of recently constructed bridges. Their use in the Kansas River Bridge at Kansas City, Kansas, illustrates the satisfactory manner in which these structural section H-piles meet certain conditions. 335 piles were used, ranging in length from 37 ft. to 81 ft. All were driven to uncompromising refusal and are believed to be seated well within heavy shale.

This and other applications of steel H-piles indicate that they are well suited for reaching bottoms otherwise economically inaccessible. Where hard driving conditions exist or where great lengths (up to 100 feet) are required, C B SECTIONS warrant thorough investigation. Our representatives will be glad to give further information.

Illinois Steel Company

SUBSIDIARY OF UNITED STATES STEEL CORPORATION

208 SOUTH LASALLE STREET CHICAGO, ILLINOIS

Largest Industrial Battery of NAVY WORK-FACTOR MACHINES

THE NAVY WORK-FACTOR TEST *consists of forcing oil between a journal and its bearings under pressure. The test journal is run for 100 hours at controlled speeds and pressures. The oil must prove its lubrication qualities as there is no cooling or interference of any kind. 100 hours on the Work-Factor Machine equals 5,000 hours in a steam turbine.*

Sinclair has recently installed at its East Chicago Testing Laboratories the largest battery of 100-hour Navy Work-Factor Testing machines ever built for any company. By means of these machines Sinclair engineers can foretell to a scientific certainty just how long an oil will stand up in any type of industrial or transportation equipment.

The "Navy Work-Factor Machine" was developed by U. S. Naval engineers for testing oils before approving them for use on battleships, submarines, destroyers, Navy aircraft, trucks, tractors and machine tools of every type. If you wish to learn more about this test applied to industrial oils the coupon below will bring you FREE the new lubrication journal WORK-FACTOR NEWS.

For specific information call or write our nearest office or any local Sinclair agency. Sinclair Refining Company (Inc.), New York, Atlanta, Chicago, Houston, Fort Worth, Kansas City.

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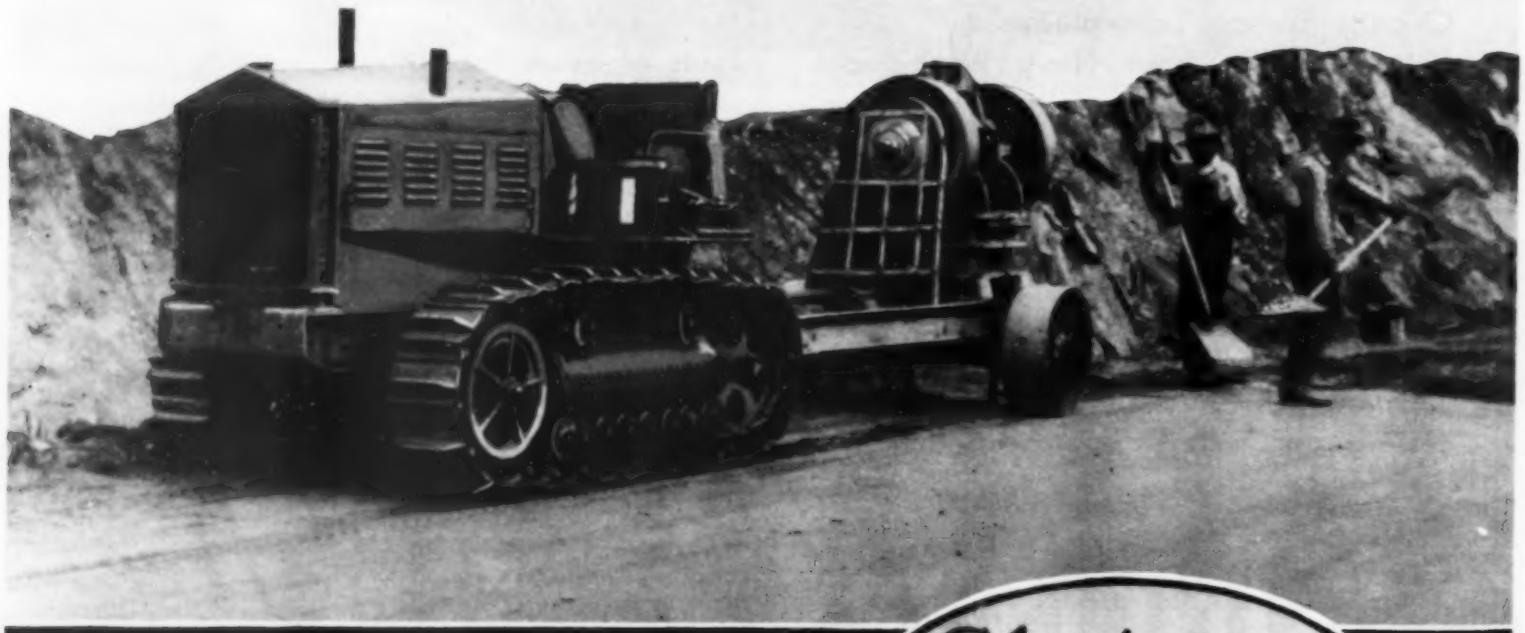
. . . In resurfacing an important Colorado highway, a saving of approximately 80% over conventional methods was made by the Cletrac shown below. A full crew of men were employed for the entire season.

The Cletrac with rock crusher operated from the power take-off, furnished crushed stone *on the job* from rocks and boulders taken from the gutter. A cost-reducing record difficult to equal—together with a full season's work for a six-man crew. Other equally impressive records of economy are made possible by Cletrac's amazing flexibility, adaptability and versatility. Write today.

Better be safe than sorry. See what Cletrac gives before you buy. We make crawler tractors exclusively; Model 80, the world's most powerful automotive unit, and models with horsepower rating 55, 35, 25, 20.

THE CLEVELAND TRACTOR COMPANY, CLEVELAND, OHIO, U. S. A.



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Crawler Tractors
Built To Endure

Three distinct advantages in T·TRI·LOK *bridge* FLOORS

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Integrally armored concrete anti-skid surface of long life and high efficiency . .

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Great strength and ruggedness combined in a thin slab of low dead weight . . .

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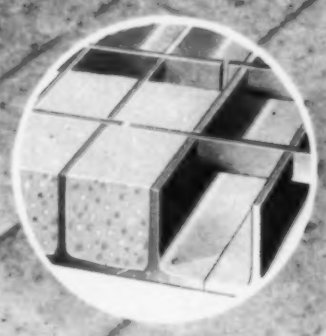
Steel, a uniform material of definite physical properties, does 80% of the work



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"VENTUBE"-carries fresh air to the heart of a mountain

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From Graham Gulch to Lincoln Gulch a bore is being driven below Independence Pass, 12,000 feet elevation, by the Twin Lakes Reservoir and Canal Company.

It is 20,130 feet long and will be known as the Twin Lakes Tunnel.

The West Portal is 10,500 feet above sea level and the work is being carried on under difficulties not ordinarily encountered in tunnel driving.

It is only logical that du Pont "Ventube", used the world over under all sorts of conditions, should be called upon to carry fresh air to the working faces. Twenty inch "Ventube" is being used and is performing to the entire satisfaction of Platt Rogers, Inc., the engineers.

Literature on this flexible, portable and economical ventilating duct, prepared for the mining and construction engineer, is available. Simply write to

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Fairfield Connecticut

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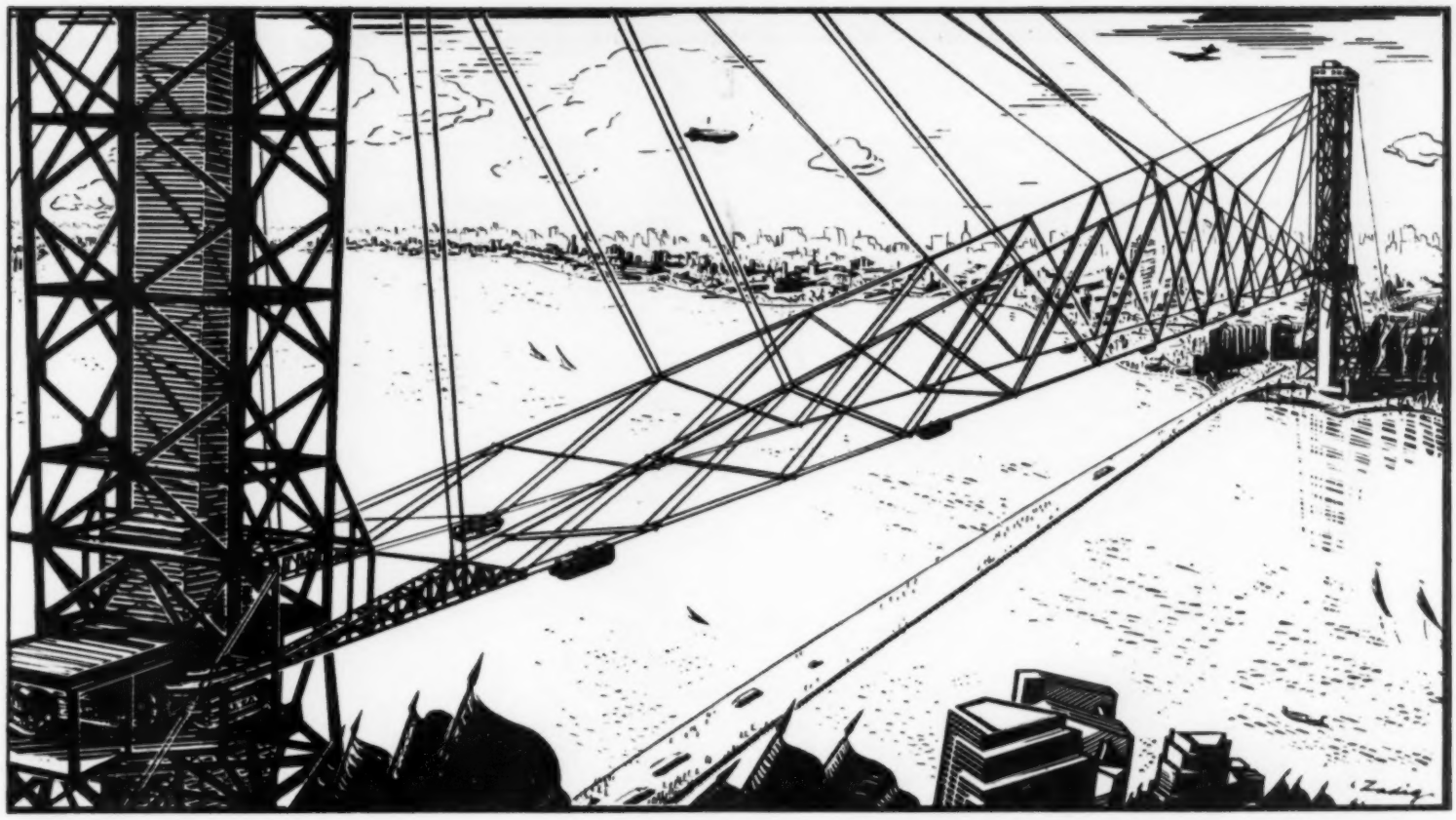
Upper Right: West End Twin Lakes Tunnel. 10,500 feet elevation

Right: West Portal Twin Lakes Tunnel. Figure by the blower is Mr. Allan Rogers.

Below: East Portal Twin Lakes Tunnel.

•

DU PONT VENTUBE



The spectacular Sky Ride, Century of Progress, Chicago, made possible through the development by Roebling of a new engineering principle in cable suspension.

1½ MILLION PEOPLE
CARRIED SURELY AND SAFELY

...on the Sky Ride, spectacular Century of Progress feature—suspension system designed and installed by ROEBLING...

Did you go to Chicago's Century of Progress? If so, you saw...and probably rode on...the Sky Ride...the modern World's Fair spectacular feature and successor to the once-conspicuous Ferris Wheel.

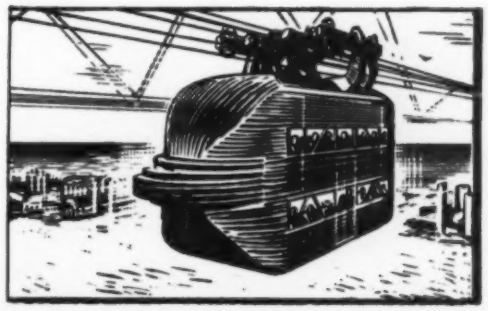
1½ million people in five months of 1933 were carried surely and safely on the Roebling Cable Suspension System...on cars which traveled a total of 50 to 60 thousand miles.

Towers are 628 feet high ... over ⅓ of a mile apart... and their Otis Elevators are equipped with Roebling Wire Rope. Span, between towers, is second longest in world. 10 Roebling "rocket" cars—each of 36 passenger capacity—travel 200 feet above ground on Roebling "Sky Ride Track Cable."

One of the 628 foot Sky Ride towers, each having four Otis Elevators equipped with Roebling Wire Rope.

Roebling was selected to design and install the Suspension System of the Sky Ride because of its vast experience and the unquestioned dependability of its bridge cables and wire rope. It designed this system in collaboration with Robinson and Steinman, well-known bridge engineers.

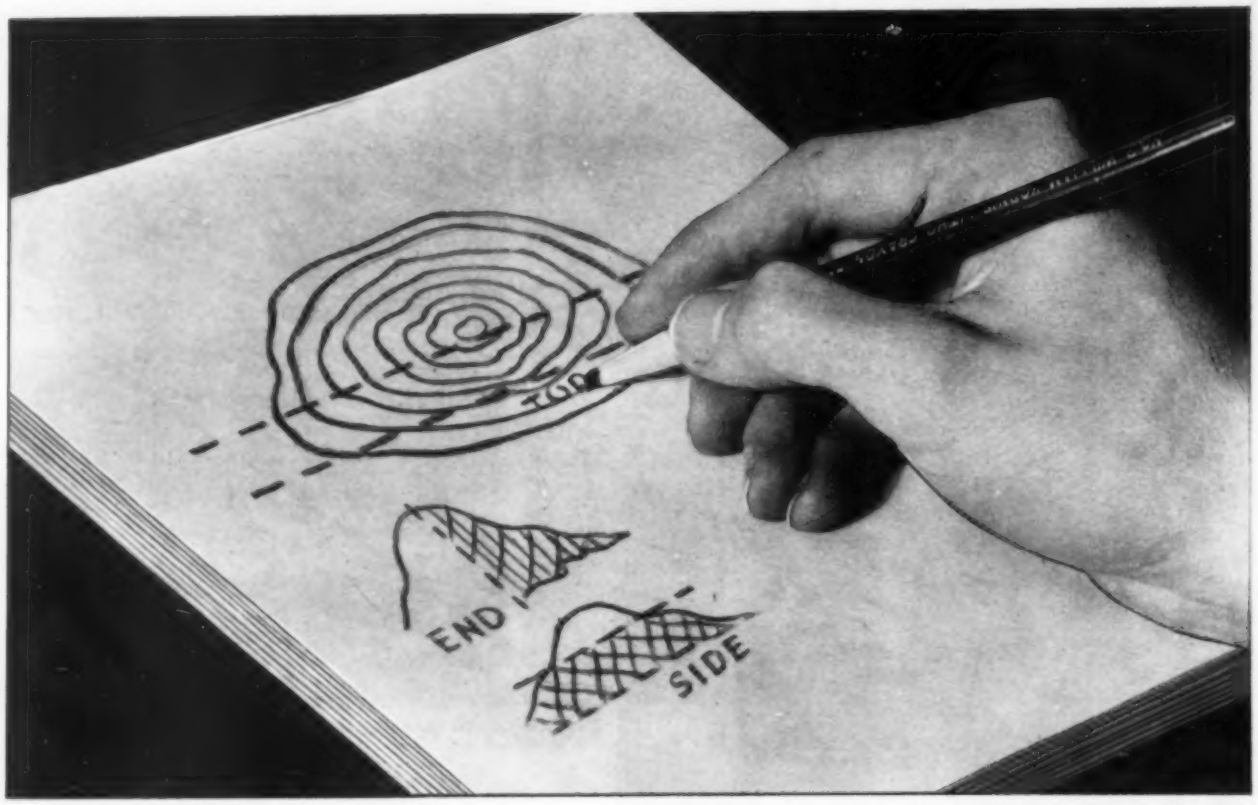
For over 90 years Roebling has been the pacemaker in wire rope and bridge cable development. These Roebling Products assure the highest obtainable degree of safe, economical service.



One of 10 Sky Ride rocket cars designed by Roebling in collaboration with the Goodyear-Zeppelin Corp.

WIRE ROPE FOR ALL NEEDS... LARGE OR SMALL: No matter how exacting the service, or how large or small the order may be, Roebling can meet your requirements. And your order will receive the same careful, prompt attention, whether for a carload of rope or merely a few feet. John A. Roebling's Sons Company, Trenton, New Jersey.

ROEBLING
The Pacemaker in Wire Rope Development



You drill from the top *down* --but how high is the top?

Lincoln said that a man's legs should be long enough to reach from his body to the ground.

Every drill hole should be *deep* enough to at least reach the floor. The deeper they are and the bigger they are, the more you will need Cordeau-Bickford Detonating Fuse.

Cordeau-Bickford is an insensitive detonating fuse. Extending from the bottom to the top of each hole, it serves as a detonator for each cartridge, and gives to each the added force of a primer cartridge. Connecting all holes with Cordeau insures the detonation of all charges; and the hook-up can be planned to relieve burden, thus getting the maximum work from your explosives.

CB28

Drill *all* your holes—well drill, wagon drill, jackhammer, as needed—then load and fire as one giant blast. This method, where practical, will mean savings in preparation and removal —and will result in better fragmentation.

Safety Fuse and Lighters

Ensign-Bickford Safety Fuse is available in a number of standardized brands, each carefully made for a particular set of conditions. The use of Safety Fuse simplifies blasting technique. Send for booklet.

Also—there are a number of Ensign-Bickford Lighters, inexpensive—and positive in action. Send for booklet.

There is a new technique in blasting, which brings new economies to operators everywhere. It is explained and illustrated in the Cordeau Book — free to executives.

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DETONATING FUSE
BICKFORD

THE ENSIGN-BICKFORD COMPANY Simsbury, Connecticut

DIPPER SHOVEL •
PLUNGER SHOVEL •
TRENCH SHOVEL •
HAMMER • CRANE

KEYSTONE 18

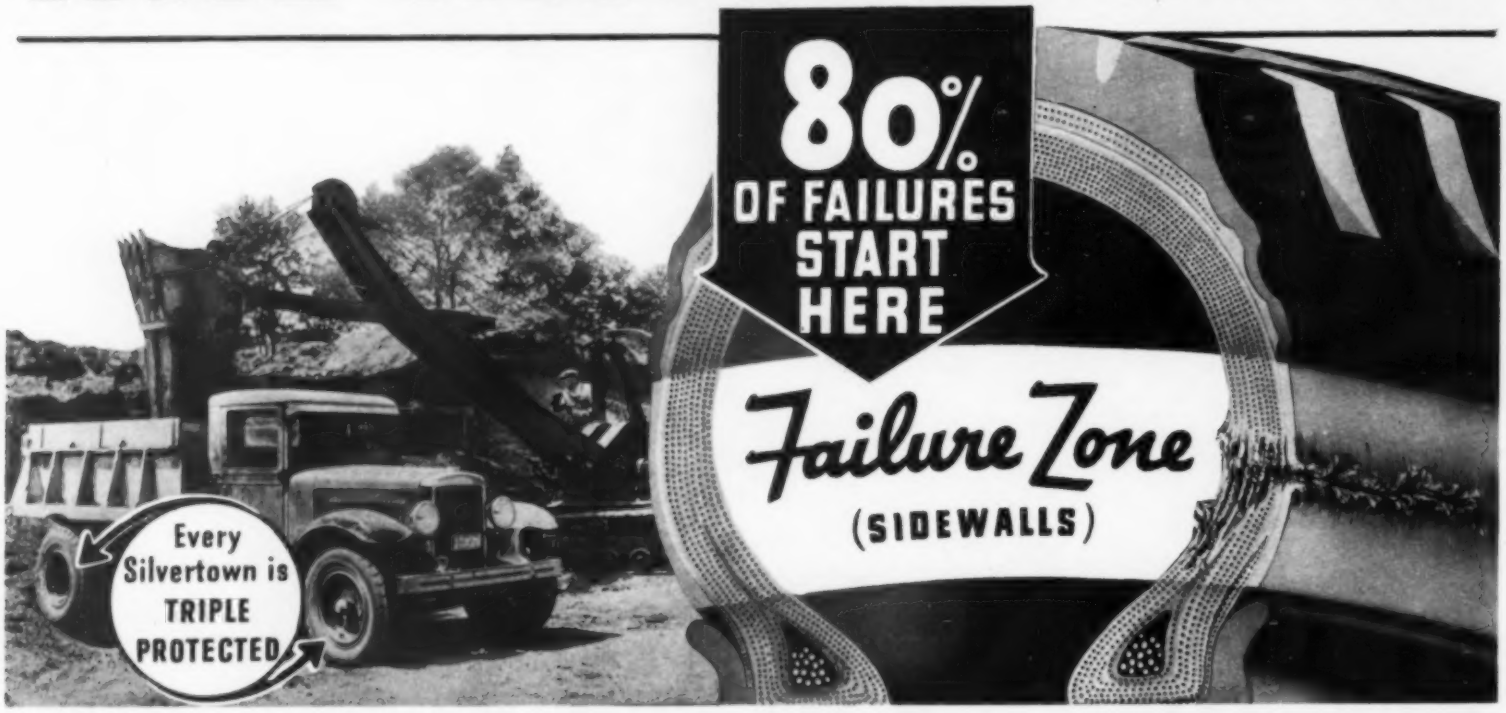
● Over 45% of the yardage on the average highway job is in cuts averaging less than four feet deep, where the dipper shovel is notoriously inefficient. The ideal shovel for highway grading would, therefore, be one combining the advantages of the Skimmer in light cuts with those of the dipper in deep cuts . . . That is exactly what you can now have in the new Keystone full revolving PLUNGER SHOVEL . . . It reduces light grading costs by 50%, yet is up to 15% faster than the dipper shovel in deep cuts. It excels in breaking old pavements, finishing grade, trimming slopes and digging stratified and decomposed rock. It can be converted in one hour to a trench shovel, crane or demolition hammer, without boom change.

Get the full facts about this epoch making machine, as well as the facts about depths of cuts in highway grading. Write today to the Keystone Driller Company, Beaver Falls, Pa. (Est. 1882). Branches: Arlington, N.J., Birmingham, Ala., Waukegan, Ill., and Joplin, Mo.

FACE THE COLD FACTS BEFORE YOU BUY ANOTHER SHOVEL

Keystone Driller Company, Beaver Falls, Pa. (Est. 1882) Branches: Arlington, N. J., Joplin, Mo., Birmingham, Ala., Waukegan, Ill.

FACE FACTS! LEARN THE TRUTH ABOUT TRUCK TIRES



GOODRICH AMAZES TRUCK OWNERS WITH TRIPLE PROTECTION AT "FAILURE ZONE"

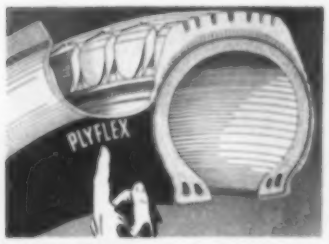
No one has ever told you the *whole truth* about truck tires. No one has mentioned the commonest cause of failures because no one had a remedy.

Do you know that the sidewall is the weakest section of most truck or bus tires? Do you know that of all tires taken out of service prematurely 80 per cent are damaged in the "Failure Zone?" Sidewall breaks and rim breaks take a toll of thousands and thousands of tires every month.

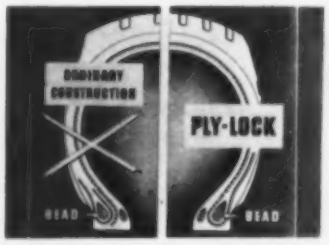
Goodrich dares to face these facts. And Goodrich has done what was said couldn't be done—made the sidewall as strong as the rest of the tire!

GET TRIPLE PROTECTION FREE

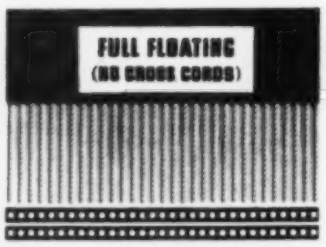
You can now get free insurance against premature blow-outs and sidewall breaks. Greater safety added to the safest tire ever built. That is what Triple Protection at the "Failure Zone" means. And here is the simple **1-2-3** story of this exclusive Goodrich million-dollar development.



1 PLYFLEX—Plyflex is a *new* tough, sturdy rubber material. Every Silvertown truck tire has a layer of Plyflex protecting the sidewall. It bears the brunt of the strains caused by the tire flexing several hundred times a minute. It distributes the stresses throughout the carcass. It prevents local weakness.



2 PLY-LOCK—The short trouble-causing plies in ordinary tires often tear loose just above the bead. A direct result of stresses concentrating at this one weak point. In Silvertowns the plies are "locked" about the beads—anchored in place. The tapered ply ends are floated in rubber. This is PLY-LOCK.

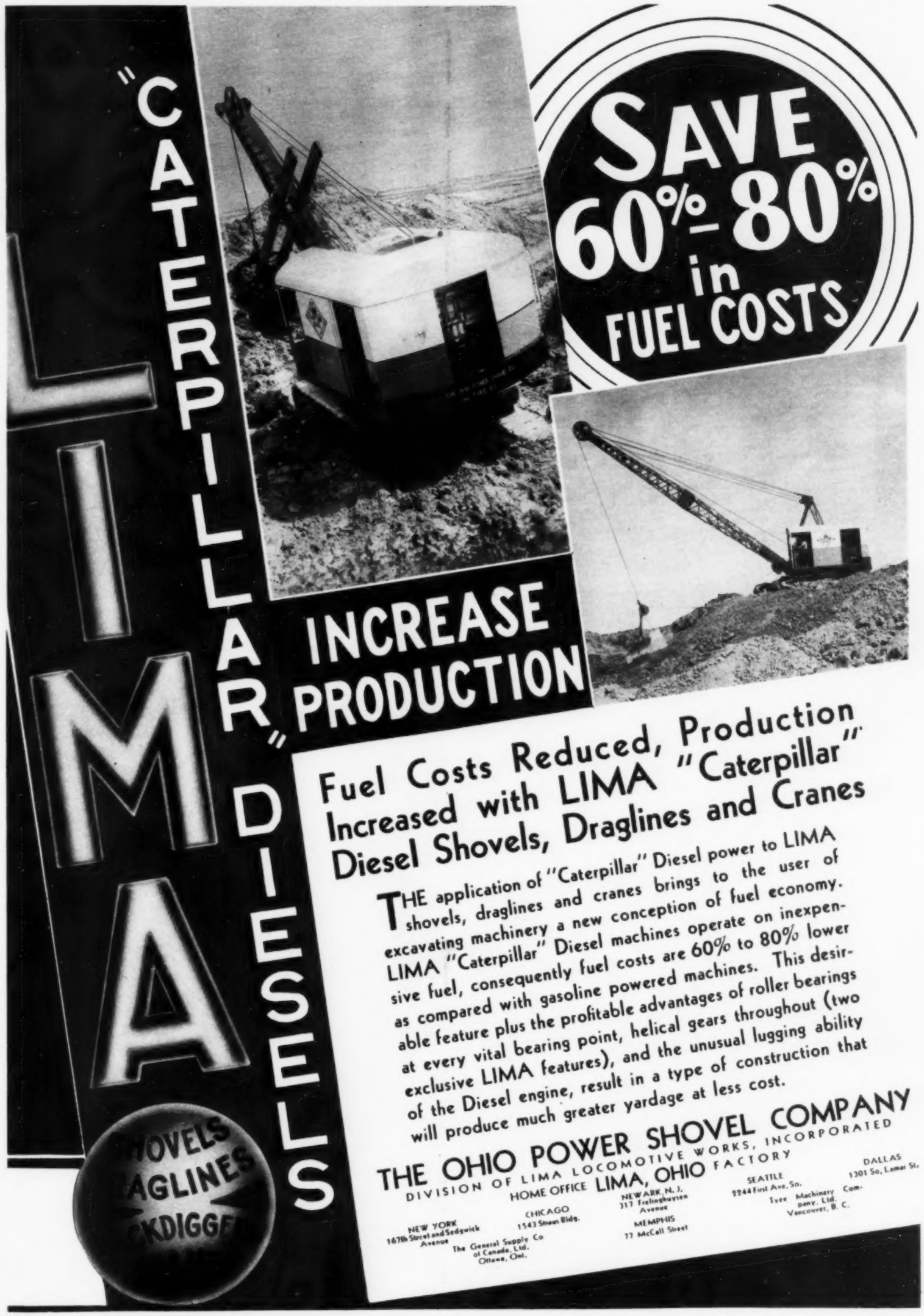


3 FULL-FLOATING CORD—100% floated-in-rubber cord fabric is used in the new Silvertowns. Each cord is surrounded by rubber. With ordinary cross-woven fabric, when cords touch each other they rub—get hot—break. In Silvertowns there are no cross cords. No friction. Fabric *wears longer.*

FREE! 48-page Safety Manual. Tells how to cut accidents—save money—build good will for your fleet. How to get free Silvertown Safety Awards for your drivers. Write Dept. T-84, The B. F. Goodrich Rubber Co., Akron, O.

HERE'S the greatest development in truck tire history in ten years. Don't take chances. One "Failure Zone" break may cost you ten, twenty, thirty dollars or more. See your Goodrich truck tire dealer today. Have him show you the new tire that costs no more than any standard truck tire. Ask him to show you the convincing demonstration of Triple Protection.

Goodrich *Triple Protected* Silvertowns
FOR TRUCKS AND BUSES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LIMA
SHOVELS
DRAGLINES
CRACKDIGGERS
INCREASE PRODUCTION
SAVE 60%-80% in FUEL COSTS
Fuel Costs Reduced, Production Increased with LIMA "Caterpillar" Diesel Shovels, Draglines and Cranes
THE application of "Caterpillar" Diesel power to LIMA shovels, draglines and cranes brings to the user of excavating machinery a new conception of fuel economy. LIMA "Caterpillar" Diesel machines operate on inexpensive fuel, consequently fuel costs are 60% to 80% lower as compared with gasoline powered machines. This desirable feature plus the profitable advantages of roller bearings at every vital bearing point, helical gears throughout (two exclusive LIMA features), and the unusual lugging ability of the Diesel engine, result in a type of construction that will produce much greater yardage at less cost.
THE OHIO POWER SHOVEL COMPANY
DIVISION OF LIMA LOCOMOTIVE WORKS, INCORPORATED
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Here is a thorough treatment of the dynamical approach in the design of earthquake resistant structures, showing its development and distinction from the statical point of view, its advantages, its methods, and its application in the design of typical structures.

Dynamics of Earthquake Resistant Structures

by JACOB J. CRESKOFF
Structural Engineer
127 pages, 6x9, illustrated, $2.50

THIS book approaches earthquake resistant design from the dynamical point of view and shows that certain paradoxes under statical assumptions become congruities under dynamical assumptions. The method presented is practical and the results obtained by its use are uniform and reasonable.

All the reliable data concerning seismic motion have been used and a method developed which takes into account the end conditions of the building, the effect of the natural period of the locality, the lateral restraint exerted by adjoining buildings, the effect of the ratio of the periods of the building and the earthquake on the seismic deflections, moments and shears, and a new and original method of distributing the seismic moments and shears among the component parts of the building.

All the data is up to date. Most of the work has not appeared before and is not to be found elsewhere. The materials dealt with are structural steel and reinforced concrete, but the method may be applied to any structural materials.

From the preface . . .

". . . large structures can be built substantially earthquake proof at a cost rarely exceeding 10 per cent of that of an ordinary building. This outlay procures increased safety for tenants and capital investments, as well as lower insurance rates. Since earthquakes are possible in all localities, neglect to provide important buildings with aseismic strength is a questionable practice."

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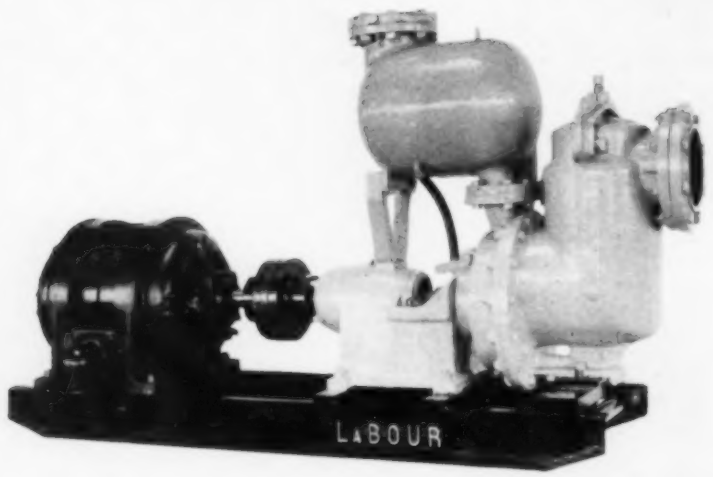
for the Kind *of* Capacity *that Counts—*



1400 GPM *against* 19″ of Vacuum

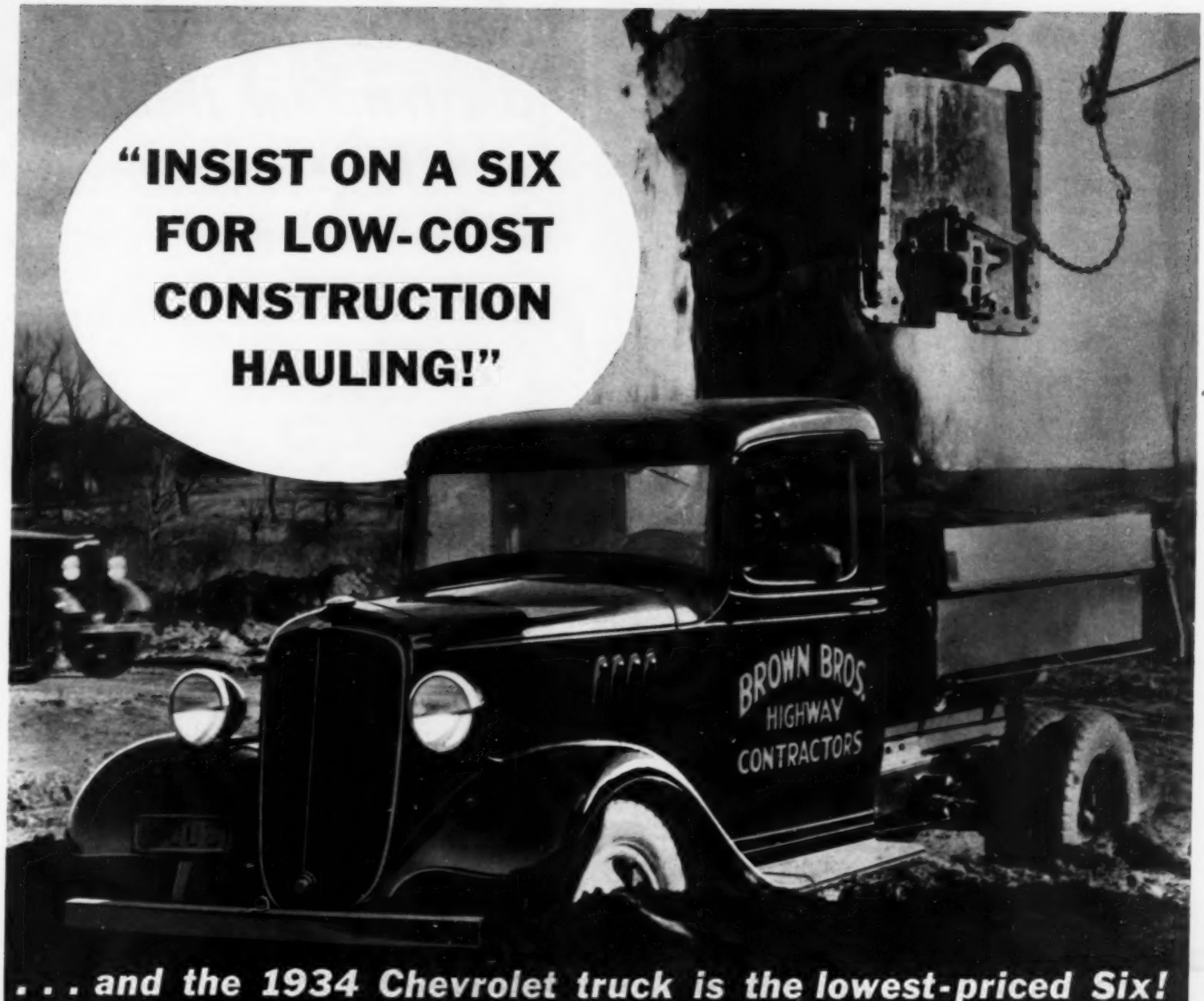
Here is one of two No. 60 LaBour Self Priming Centrifugal Pumps shipped to Merritt, Chapman & Whitney, one of the contractors for the Winona Flood Control Dam at Winona, Minn.

In well point service this pump delivered approximately 1400 g. m. p., handling 60 well points, 1¼″, and working under a vacuum of 19″ of mercury, which is the equivalent of a suction lift of 21½ feet. The pump is powered with a 40 H.P. electric motor.

Only the exclusive LaBour principle of HYDRO-BALANCE can make such performance possible. Even under high vacuum or high pressure there is no wasteful recirculation to lower capacity and consume power. The rugged, man-size parts of LaBour Pumps are built to withstand severe service, and the simplicity of design and construction makes for lasting dependability.

LaBour Pumps can handle your difficult problems economically. Tell us your problem and let us prescribe the LaBour Pump which will save you time, trouble and hard-earned cash.

THE LABOUR COMPANY, INC.
409 Sterling Ave.
ELKHART, IND.



. . . and the 1934 Chevrolet truck is the lowest-priced Six!

CHEVROLET

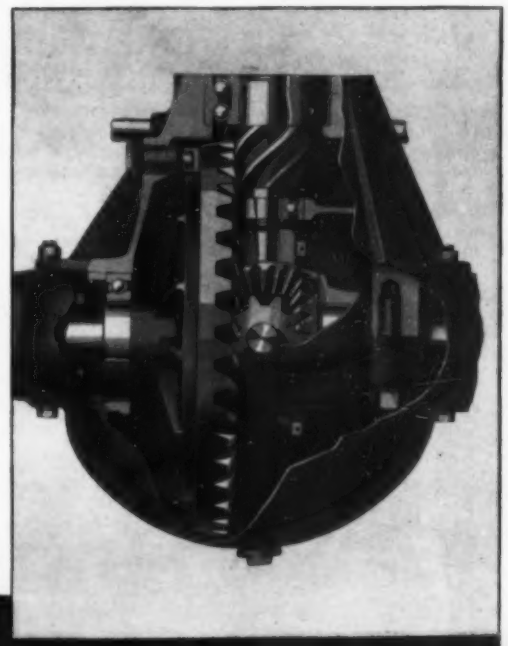
You can save money on every haul, if your truck is a *Six*—a *valve-in-head* Six! With more than six cylinders, you face the prospect of higher costs for gas, oil and maintenance. With less than six, excessive vibration runs up costs from added wear and tear. *Six* is the right number of cylinders—and the *lowest-priced* six-cylinder truck is the 1934 Chevrolet. Chevrolet has developed the six-cylinder overhead-valve engine to its most economical point, and gives it to you in a big, husky truck—*not a made-over passenger car, but all truck throughout.* Truck frame, truck brakes, truck springs, axles, gears and clutch—and a truck engine that delivers greatest pulling power at speeds where you can use it. In fact, the greater strength and dependability of the 1934 Chevrolet truck recommend it for all types of hard construction hauling. It stays on the job doing work you never expected from a 1½-ton truck—and it saves money both ways, hauling a load or coming back empty.

CHEVROLET MOTOR COMPANY, DETROIT, MICHIGAN

Compare Chevrolet's low delivered prices and easy G. M. A. C. terms. A General Motors Value

HEAVY-DUTY REAR AXLE

Big axle shafts, straddle-mounted pinion gear, 4-pinion differential, double-row wheel bearings, one-piece banjo-type housing with a big removable plate—all these and many more special features give Chevrolet rear axles an extra strength that is rarely needed in construction hauling. The rear axle and the transmission combined have the lowest final gear ratio of any 1½-ton truck.



CHEVROLET SIX-CYLINDER TRUCKS

clear business skies in construction industry

BUSINESS prospects in the engineering-construction field have been discussed by the McGraw-Hill construction papers in encouraging terms ever since last fall. The figures have permitted no other viewpoint.

We are still talking this way—only now we can do it with greater enthusiasm. That old mental hazard of the construction industry—winter—is behind us. No longer can it interfere with the construction plans of 1934.

The figures from January to March reflect the preparations for spring and summer building. Some of these factual straws are shown herein. They indicate the direction of the wind and measure the first-quarter acceleration with which we approach the warm weather construction peak.

It is natural, of course, that the leading publications in the construction industry should show a corresponding pick-up in advertising. Manufacturers of equipment and materials, sensing the possibilities for business, are dusting off selling plans. Advertising appropriations are being withdrawn from cold storage. Their advertising men, rubbing their eyes and stirring themselves, proclaim with well-founded confidence that spring is in the air.

What a different kind of spring it is!

New capital made available since January for engineering-construction work was 386% greater than in the corresponding months of 1933. This includes state and municipal bonds, corporate issues and PWA allotments.

Contracts awarded so far in 1934 are more than 23% higher in value than those awarded a year ago.

The McGraw-Hill *Construction Daily* published 42% more construction reports in January and February than in the same period of 1933.

The issues of *Engineering News-Record* in the first quarter will show a 60-page advertising gain over the first quarter of 1933.

Construction Methods in the same period shows an advertising increase of 38 pages, the March issue being the largest in three years.

60 new advertisers have started 1934 schedules in these two publications since the first of the year.

Engineering News-Record and *Construction Methods* together carried more display advertising in January and February than all other national publications reaching contractors and engineers.

CONSTRUCTION METHODS

330 W. 42nd Street - New York

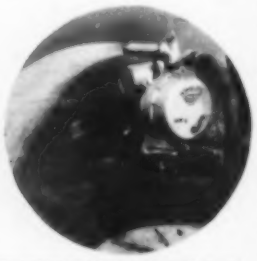
PORTABLE

CENTRIFUGAL PUMPS

that a man can easily carry

The Homelite portable, self-priming centrifugal pump weighs only 89 pounds; can easily be carried by one man. It is a complete unit with a built-in gasoline engine. Pumps from 2 to 7500 gallons per hour. Handles muddy water with solids. Primes quickly.

Thousands of Homelite Pumps are in service on construction jobs all over the world. Write for descriptive bulletin.



HOMELITE CORPORATION

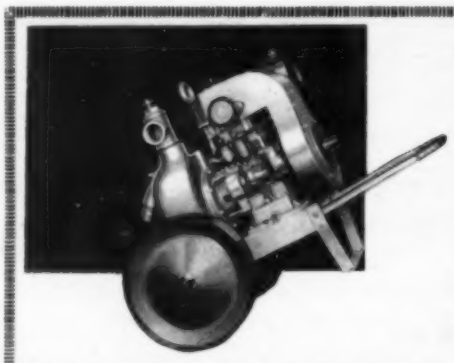
75 Riverdale Ave., Port Chester, N.Y.

HOMELITE CORPORATION
75 Riverdale Avenue, Port Chester, N. Y.
Gentlemen:
Please send me bulletins describing Homelite Portable Pumps.

Name.....

Company.....

City..... *State*.....



Primes at over 25 ft. lifts—without hand adjustment.

No hand adjustment for recirculation cut-off.

Compact, rugged — one moving part.

3 times bigger water passages.

GIANT CAPACITY, FASTEST 100% AUTOMATIC PRIME with JAEGER 2", 3", 4", 6", 8", PUMPS!

Self-cleaning shell.

Timken or ball bearings.

No shaft packing.

Capacities 10,000 to 125,000 g.p.h.

Write for Prices!

The Jaeger Machine Co.

800 Dublin Avenue Columbus Ohio

NEW LIFE for your tracklaying wheel units with these NEW Athey Forged-Trak Replacement Assemblies

for all makes of WHEELS

Once again Athey engineering points the way to bigger economy—greater service—for YOU. In the new Athey Forged-Trak Replacement Assembly, you get *exclusive* advantages, *exclusive* features of design never before attained. For maximum performance and lowest hauling costs, replace with Athey Forged-Trak Replacement Assemblies. They are available for replacement on all makes of wheels.

Here are some of the reasons why it PAYS to replace with Athey FORGED-TRAK Assemblies:

—**TRACK PIN BEARINGS SEALED** against abrasive action of sand or mud

—**FULL FLOATING LOCK PINS** provide easy rebuilding in the field—assure maximum bearing surface and lengthen pin life

—**DROP-FORGED LINKS** with integral interlocking arms and bolted-on track plates

—**RIGID TRACK STRUCTURE** eliminates motion under load, the greatest single cause of track wear

—**SIMPLIFIED CONSTRUCTION** with maximum sturdiness for long life

—**POSITIVE, NON-CLOGGING, SELF-CLEANING TRACK**—operative under sand, snow, mud or freezing conditions.

Athey Forged-Trak Replacement Assemblies are available for replacement on all makes of wheels. Replace NOW for lasting economy.

ATHEY TRUSS WHEEL CO., 5631 W. 65th St., Dept. J Chicago, Illinois
Cable Address: "Trusswheel" Chicago

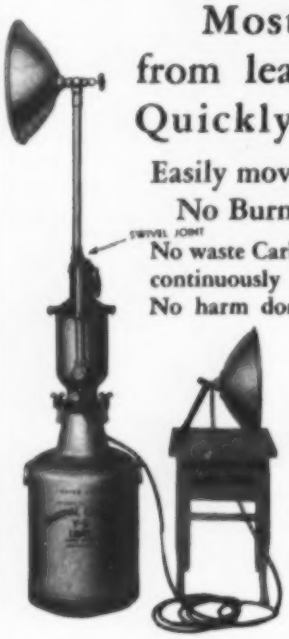
ATHEY Forged-Trak
REG. TRADE MARK

NATIONAL CARBIDE

V-G LIGHTS

Most Light from least Carbide Quickly Charged

Easily moved—No wires
No Burner Troubles



No waste Carbide whether used continuously or intermittently
No harm done if tipped over

—

Extension to X-100 DOUBLES THE CANDLE POWER *fastens anywhere*

—

Always use NATIONAL CARBIDE *"In the Red Drum"* Distributors Coast to Coast

—

WRITE FOR COMPLETE INFORMATION

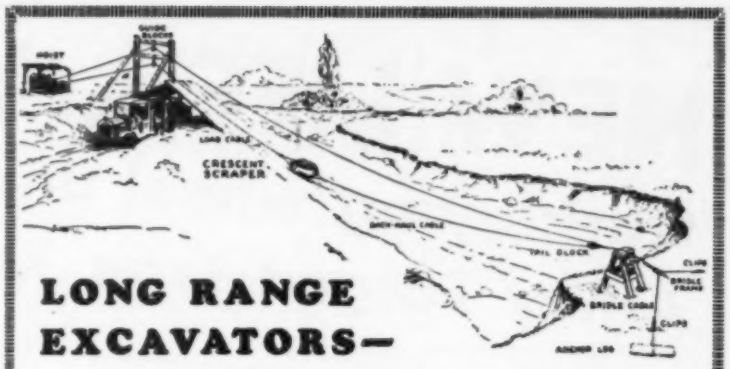
—

Y199
NATIONAL CARBIDE V-G HANDY LIGHT
Burns about 5½ hours on 1¾ lbs. of 14-ND Carbide, 2 gals. water; delivers about 1500 c.p. Weighs 37 lbs. charged—easy to carry, handy in emergencies.

WL1-C1
NATIONAL CARBIDE LANTERN
Burns 8 hrs. on 8 oz. of Carbide. Brilliant rear signal of red, blue or green, no extra charge . . . Ideal for emergency lighting on road at night.

X-100
NATIONAL CARBIDE V-G LIGHT
About 8,000 c.p. for 12 hours on 7 lb. charge of National Carbide. Easily handled by one man. Weight 35 lbs. empty; 98 lbs. full.

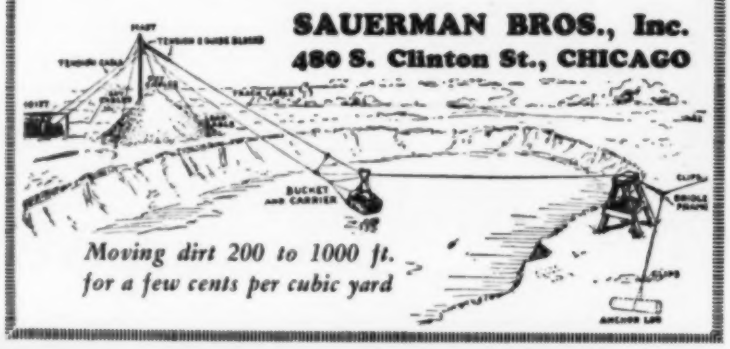
NATIONAL CARBIDE SALES CORP.
LINCOLN BUILDING
Opposite Grand Central, NEW YORK



LONG RANGE EXCAVATORS—

Crescent Drag Scrapers and Sauerman Slackline Cableways are low-cost excavators designed to dig and move a maximum yardage of earth with a minimum expenditure of man-power and motive-power.

If you are interested in studying new ways of working sand and gravel pits, grading highways, excavating canals, cleaning out reservoirs, and other earth-moving work, send for the Sauerman Catalog No. 16.



Moving dirt 200 to 1000 ft. for a few cents per cubic yard

SAUERMAN BROS., Inc.
480 S. Clinton St., CHICAGO

LE TOURNEAU

Now Offers You

An 8 YARD
CARRYALL SCRAPER
On Pneumatic Tires
Built for 50 H. P. Tractors

Let us tell you where the nearest unit is operating

● These two new carriers follow the identical design and operation of the popular 12-Yard CARRYALL SCRAPER

alloy steel throughout
All electric welded construction

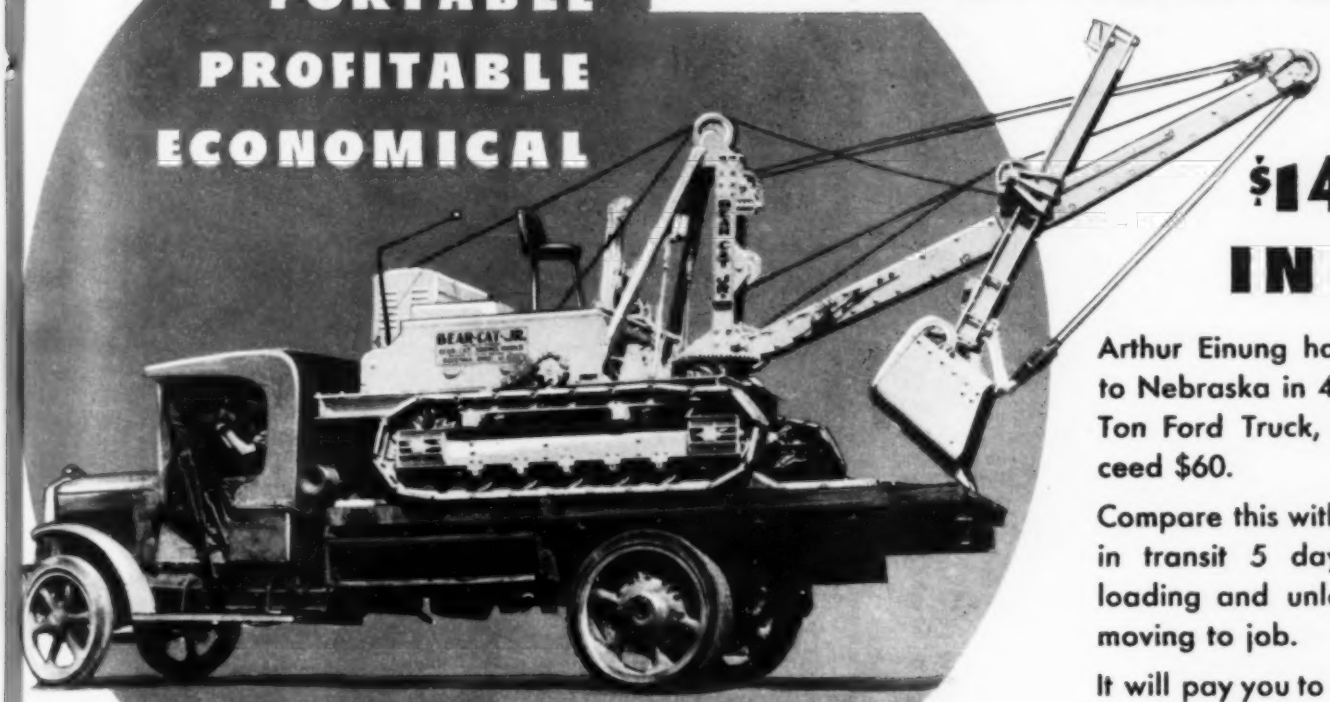
R. G. LE TOURNEAU, INC.
P. O. Box 1290 STOCKTON, CALIFORNIA

A 6 YARD
CARRYALL SCRAPER
On Pneumatic Tires
Built for 35 H. P. Tractors

Ask our Engineering Department for production data and descriptive literature

800 MILES TO A JOB IN 48 HOURS

PORTABLE
PROFITABLE
ECONOMICAL



$140 SAVED IN TWO DAYS

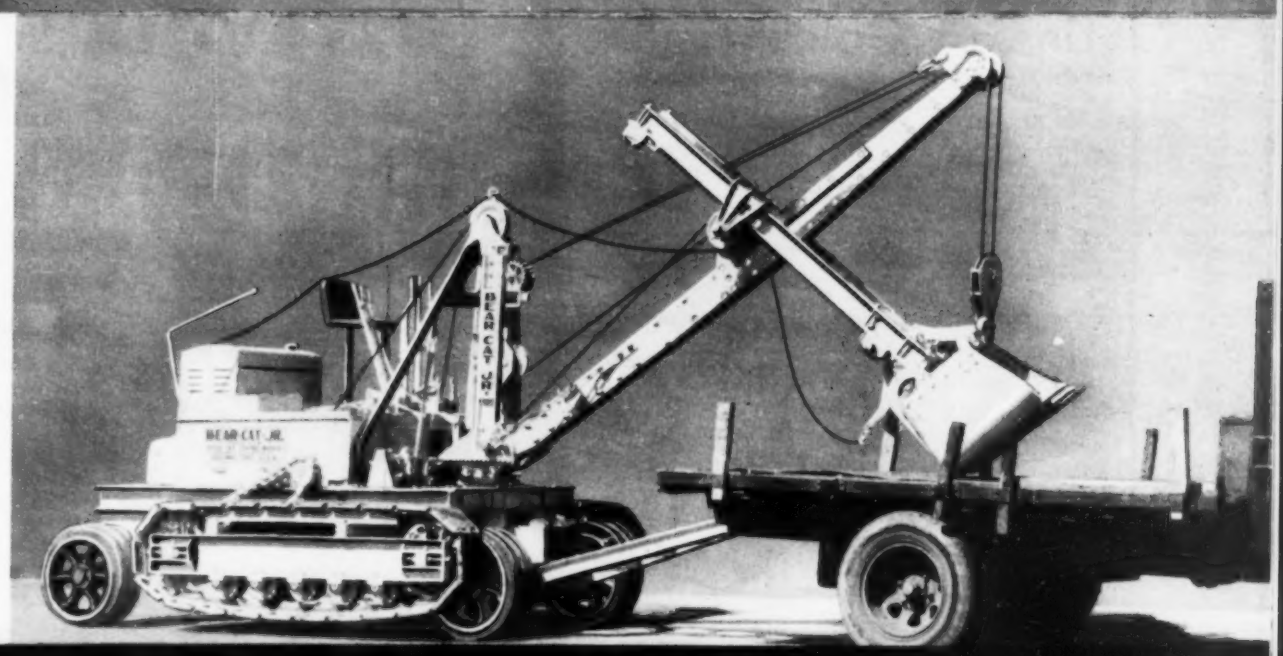
Arthur Einung hauled his Bear Cat Jr. from Ohio to Nebraska in 48 hours. Total expense for 1½ Ton Ford Truck, trailer and men would not exceed $60.

Compare this with freight shipment. Time required in transit 5 days... Freight cost $200... plus loading and unloading cost... plus expense of moving to job.

It will pay you to replace slow, clumsy, expensive-to-operate machines with a Bear Cat Jr.

YOU CAN'T BEAT IT FOR PORTABILITY

25 MILES PER HOUR TO ANY JOB



SEND FOR FREE BOOK

"BEAR CAT JR. FACTS"

It explains

WHY—the Jr. costs $1000 less than any other new shovel or crane

HOW—it digs 250 yards of dirt on 10 gallons of gas and ¼ pint of oil

WHAT—moving from job to job at 25 miles per hour saves you on every job.

You will then realize why the Bear Cat Jr. is the world's greatest shovel value.

★ Bearcat Shovel Works ★

DIVISION BYERS MACHINE CO.

10 SYCAMORE STREET · · ·

CONCRETE (CURING) FACTS

HUNT PROCESS and RITECURE METHOD

1—Spray Hunt Process or Ritecure on concrete directly behind the finishing machine.

Hay and Water Method

1—Cover concrete with burlap,
2—Water burlap for 24 hours,
3—Remove burlap,
4—Cover concrete with 6 inches of hay,
5—Water hay, and keep saturated for 10 days,
6—Remove wet hay,
7—Sweep pavement.

Ordinary Bituminous Method

1—Cover concrete with burlap,
2—Water burlap for 24 hours,
3—Remove burlap,
4—Spray concrete with bituminous mixture.

"HUNT PROCESS"

Black when applied, darkens the concrete. Forms a permanent anti-glare surface.

"RITECURE"

White when applied, forms a transparent, flexible film, leaves concrete its natural color.

Whether a road surface shall be black or natural color is a matter of opinion, but it is a definite fact that either of these materials offer a most economical and satisfactory method of curing because:

They are applied immediately behind the finishing machine; eliminate the use of water retentive materials; are sprayed on the "green" concrete; film easily and form a uniform, impervious coating.

Both materials are sold on the basis of yards cured, consequently the contractor knows his curing costs before the job starts, and the engineer knows that the work is efficiently cured—with no skimping.

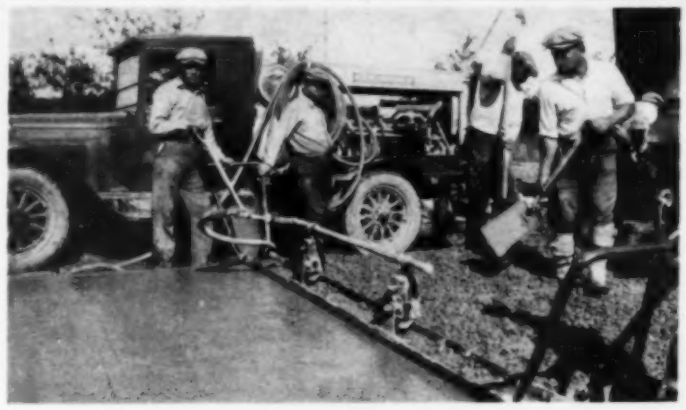
You should know the facts about curing whether you design, supervise or build concrete pavements. Ask us!

THE JOHNSON-MARCH CORPORATION

52 Vanderbilt Avenue, New York, N. Y.

BRANCH OFFICES:

2523 Wilshire Blvd. Houston, Texas
7012 Stanford Avenue Los Angeles, Cal.
Russ Building San Francisco, Cal.



VIBRATING SCREED BOARD

The newest development in the Munsell (Air Driven) Concrete Vibrators for making a more dense and durable pavement.

Permits the use of dry mixes (1-in. slump), less overtime for finishing.

Tests by U. S. Bureau of Public Roads shows conclusively that the use of vibrating equipment allows a dryer mix resulting in stronger and more durable concrete. The New Jersey State Highway Comm., recognizing this fact, has made vibration a part of their 1933 specifications.

Write for circulars describing other models for internal and external vibration.

MUNSELL CONCRETE VIBRATORS

995 West Side Ave. Jersey City, N. J.

A New Economical Line of Galco Timers

This is Galco Timer No. 1010

60 Minute Register. 12 Hour Register. Fine 7 Jewel movement . . . By the makers of GALLET TIMERS

JULES RACINE & CO.
20 West 47th St., New York, N. Y.

Please send your Catalog of Galco Timers.

Name.....

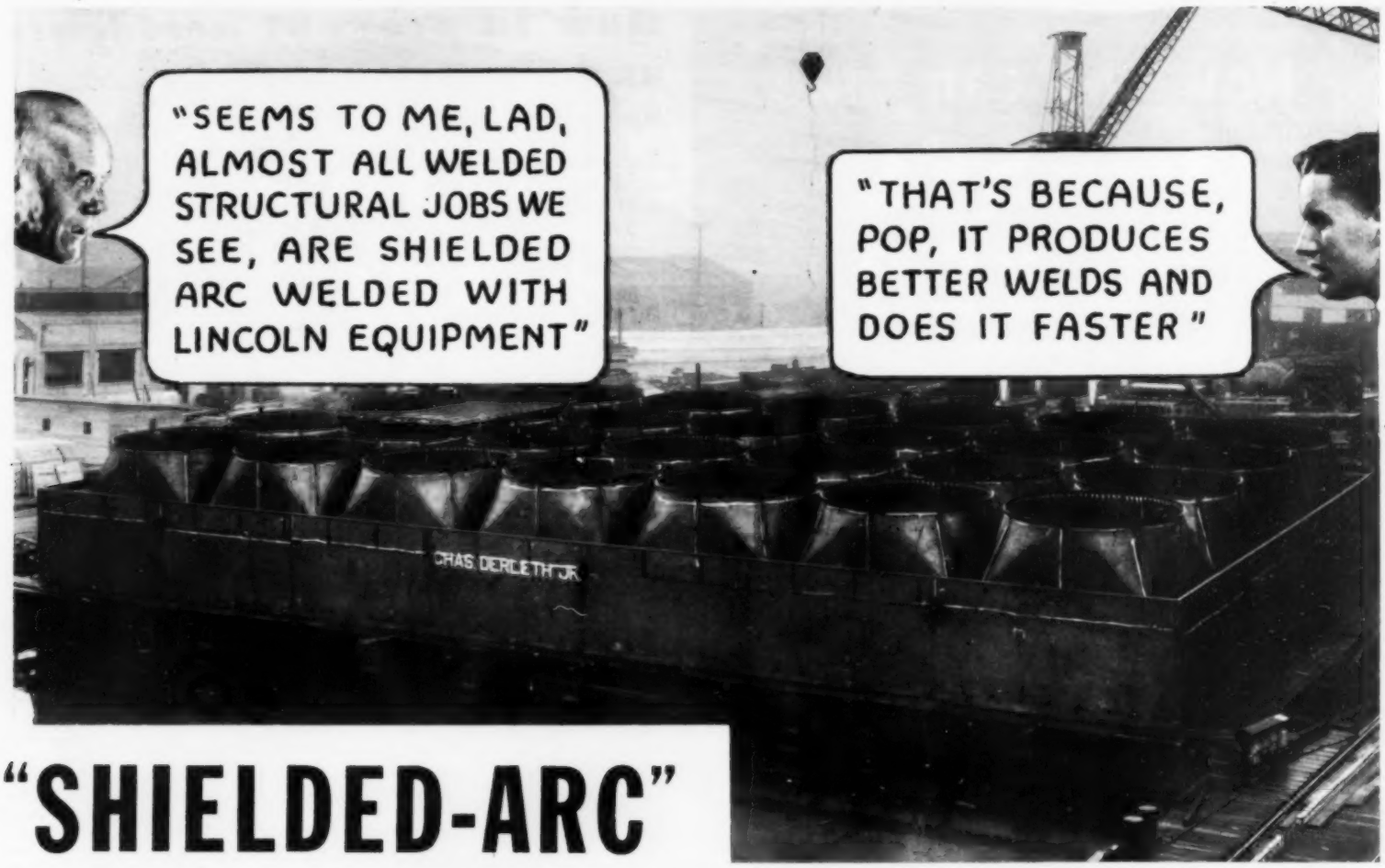
Address.....

City.....CM

If you want to BUILD A PROFIT *Everytime* you BUILD A ROAD

USE A STOP WATCH

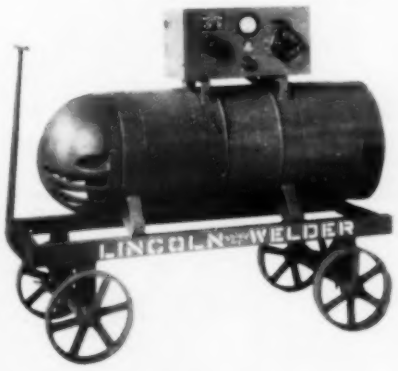
For every field of construction—there is a Galco Timer—specifically designed to serve that field.


"SEEMS TO ME, LAD, ALMOST ALL WELDED STRUCTURAL JOBS WE SEE, ARE SHIELDED ARC WELDED WITH LINCOLN EQUIPMENT"
"THAT'S BECAUSE, POP, IT PRODUCES BETTER WELDS AND DOES IT FASTER"
CHAS. DERLETH JR.

"SHIELDED-ARC" WELDS CAISSON CUTTING EDGES FOR SAN FRANCISCO-OAKLAND BRIDGE

More than 400,000 lineal feet of welds, produced by the shielded arc process with Lincoln "Fleetweld" electrodes, are contained in the seven caisson cutting edges recently completed for the piers of the San Francisco-Oakland bridge. By using Lincoln "Fleetweld" electrodes the builders of these caisson cutting edges were able to more than satisfy the minimum requirements of 65,000 lbs. per sq. in. tensile strength and ductility of 18% elongation in two inches, for all welds made in flat, vertical or overhead positions.

Welds produced by Lincoln "Fleetweld" electrodes and "Shield-Arc" welders also have greater resistance to fatigue, impact and corrosion than mild steel. It's these high values plus the faster welding speed of Lincoln equipment that make its use most economical.



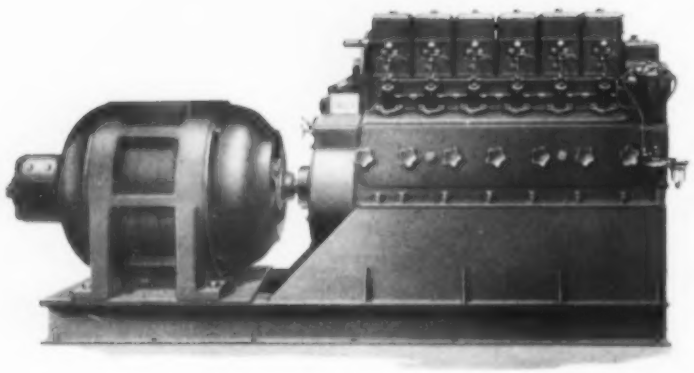
LINCOLN

NEW IN WELDING
"Lincontrol"
—remote control without extra cables or portable accessories. Write for bulletin.

THE LINCOLN ELECTRIC COMPANY, *Largest Manufacturers of Arc Welding Equipment in the World,* **CLEVELAND, OHIO**

"SHIELD-ARC" WELDERS AND ELECTRODES

Now you can take DIESEL POWER *right to the job!*



● The new F-M light weight high speed Diesel brings Diesel economy right to the job that is "on the move" or only temporarily stationary.

This engine is light enough for truck mounting or other forms of easy transportation. It is big enough, 10 to 60 h.p., one to six cylinders, to furnish light for night operations, it's big enough to furnish "air" to a lot of pneumatic tools. It will operate a good sized hoist. It will drive grinders, hammers or any other tools you must use on the job. It's the cheapest form of power you can use on a mixer or paver. It will drive a pretty big pump.

This engine enables you to take plenty of economical power right to the job or along with the job as it progresses. It means the cheapest form of power known to engineering has become available to the construction industry.

These engines are furnished, as you desire, with or without generator, pump or compressor.

For full information write Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill. 32 branches at your service throughout the United States.

Pioneer Designers and Manufacturers of Power, Pumping and Weighing Equipment 104 Years

FAIRBANKS-MORSE
DIESEL ENGINES

6058-0A31.14

How to prevent *accidents* and reduce costs *in heavy construction work*

Just published

Safety and Economy in Heavy Construction

by **RAY J. REIGELUTH**

Vice-President, C. W. Blakeslee & Sons, Inc., New Haven, Conn.

237 pages, 5 x 7½, flexible, 47 illustrations, $2.50

THIS book grew out of superintendents' meetings in the author's own organization because it was discovered in the course of the meetings that there was considerable lack of information on essential topics on the part of even high-grade foremen.

The book shows how to safeguard men working on heavy construction jobs—how to carry out methods that prevent accidents and save waste—how to employ special techniques that cut costs. All of the information is presented simply and directly in a handy, usable way.

It is a practical book, based on tested experience, for superintendents and foremen in the field, and it presents details of construction work not available in any other field book. Design engineers and estimators will find the book helpful because many of the data offered are not elsewhere available in such compact and workable form.

Among the topics covered are:

—the setting of portable boilers;
—the proper procedure in firing boilers;
—the care of boilers to insure safe operation;
—the proper care and use of manilla rope, steel cable and chains;
—equipment inspection routine;
—the proper use of gin poles, derricks and cranes;
—what to look out for in excavation work;
—the proper method of unloading piles;
—the transporting, handling and storing of explosives;
—safe methods for the construction and erection of concrete forms.

Much of the material is not available in any other book. For instance, field men will value the detailed instructions on vital points of performance, such as the correct rigging of derricks, the design of cofferdams and cofferdam bracing. The tables on rope, chain and cable capacities are also noteworthy; they are the result of the author's own computations. The tables on the capacities of timbers and plank and on earth pressures are again the result of long observation and practical experience, and consequently are particularly valuable to men on the job. The whole book is a working manual which field superintendents and foremen will find of daily helpfulness.

Chapter Headings

1. SAFETY ORGANIZATION
2. SETTING PORTABLE BOILERS
3. FIRING BOILERS
4. CARE OF BOILERS
5. RIGGING
6. WIRE ROPE AND SHEAVES
7. CHAINS
8. GIN POLES, DERRICKS AND CRANES
9. EXCAVATION
10. PILE DRIVING
11. EXPLOSIVES
12. CONCRETE FORMS
13. GASOLINE EQUIPMENT
14. HIGHWAY CONSTRUCTION
15. BUILDING, TOOLS, MISCELLANEOUS
16. GENERAL SAFETY RULES

See it 10 days on approval—Send this coupon

ON-APPROVAL COUPON

McGRAW-HILL BOOK COMPANY, Inc.
330 W. 42nd St., New York, N. Y.

Send me Reigeluth—Safety and Economy in Heavy Construction for 10 days' examination subject to approval or return. Within 10 days of receipt I will send $2.50, plus a few cents for postage and delivery, or return the book postpaid. (We pay postage on orders accompanied by remittance.)

Name .....

Address ..... Position .....

City and State ..... Company .....

(Books sent on approval in U. S. and Canada only.

CM-4-34

● *You* can have TRU-LAY Preformed Wire Rope in the size, grade, construction and LAY (Lang or Regular) required on your job.

You can cut wire rope costs materially NOW with TRU-LAY, because the wires and strands are preformed in manufacture to take the exact shape of the rope. They lie *relaxed* in the rope body from the time it is first taken from the spool until it has given its last ounce of service.

Preforming eliminates:

1. Destructive internal stress
2. Unbalanced strand tension
3. Low and high stranding
4. Seizing
5. Tendencies to kink
6. Difficulties in splicing
7. Difficulties in handling

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Construction Methods

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343 Sansome Street · San Francisco, California

To MANUFACTURERS
This space costs 37½ cents per thousand readers. A trifling sum compared to the service it can render in contacting possible buyers of your products.

READERS of Construction Methods—this introduces to you a new advertising section. Through it we hope to serve you more thoroughly. That is why it is called the "Service Section". The new, small units of space available here provide opportunity for presenting many additional products and services not heretofore brought to your attention. To be informed—and reminded—of these further aids to efficient and economical construction operations we suggest that you check this section regularly.

MANUFACTURERS of Construction Equipment—to you and the manufacturers of other products used in construction work—and those offering special services to the industry—this new section offers an inexpensive means of keeping such products or services regularly before the readers of this paper—your potential customers. The new, small, spaces available here provide opportunity for you to be represented in every issue at low cost. Can we serve you through this section?

ALPHABETICAL INDEX TO ADVERTISERS

This index is published as a convenience to the reader. Every care is taken to make it accurate, but *Construction Methods* assumes no responsibility for errors or omissions.

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STABILITY-POWER-*Speed*

THE Link-Belt is fast! It has POWER—ample power for generous speeds in all kinds of work. Speed and power go hand in hand. Backing up the Link-Belt's power and speed is a balanced design, a sturdy construction. That is why the Link-Belt performs so reliably, and "stands the gaff" in day-in-day-out hard service.

From ¾ to 2½ yds. capacity, heavy-duty built. Gasoline engine, Diesel or electric motor drive.

LINK-BELT COMPANY, 300 W. Pershing Road, Chicago

San Francisco, Garfield & Co.; Los Angeles, Harry C. Collins Machinery Co.; Los Angeles, Link-Belt Company; Boise, Intermountain Equipment Co.; Denver, Link-Belt Company; Phoenix, Mine and Smelter Equipment Co.; Portland, Loggers & Contractors Machinery Co.; Seattle, A. H. Cox & Co., Inc.

LINK-BELT

SHOVEL-
CRANE-
DRAGLINE

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